



# 560 VENTILATOR CLINICIAN'S MANUAL

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# Preface

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## Purpose of This Manual

This manual contains important information regarding the safe operation of your Puritan Bennett™ 560 Ventilator. Your ventilator is an electrical device that can provide years of useful service with the proper care, as described in this manual.

Ensure that you read and understand the instructions contained in this manual before operating the ventilator.




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### WARNING

**Before operating the ventilator, read, understand, and strictly follow the information contained in Chapter 1, "Safety Information".**

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## Qualification of Personnel

Installation and maintenance of the device must be made by authorised and trained personnel. In particular, training for the handling of products sensitive to electrostatic discharges must include the use of Electrostatic Discharge (ESD) protection devices and knowledge of the following symbol's meaning:  as well as using original spare parts and respecting quality assurance and traceability rules approved by Covidien.

## Warranty

Information regarding your product warranty is available from your sales representative or Covidien.

## Extended Service

The Puritan Bennett™ 560 Ventilator offers extended service contracts/warranties for purchase when the ventilator is purchased. Please contact your local Covidien Sales or Service Representative for additional information.



For online technical support, visit the SolvIT<sup>SM</sup> Center Knowledge Base by clicking the link at <http://www.puritanbennett.com>. Here, you will find answers to frequently asked questions about the product and other Covidien products 24 hours a day, 7 days a week. If you require further assistance, contact your local Covidien representative.

# Technical Support

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# 1 Safety Information

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## 1.1 Definitions

This manual uses three indicators to highlight critical information: Warning, Caution, and Note. They are defined as follows:



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**WARNING**

**Indicates a condition that can endanger the patient or the ventilator operator.**

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**Caution**

Indicates a condition that can damage the equipment.

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Note:

Indicates points of particular emphasis, that make operation of the ventilator more efficient or convenient.

It is essential to read, understand and follow these instructions before using the Puritan Bennett™ 560 Ventilator. In order to use the ventilator correctly and efficiently and to help prevent incidents, please pay particular attention to sections 1.2, “Warnings”, as well as all warnings and cautions contained throughout this manual.

## 1.2 Warnings



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**General Warnings Regarding Use**

- The ventilator must be used only under the responsibility and on the prescription of a doctor.
  - The ventilator must be used according to its intended use. Refer to section 2.1, “Indications for Use”.
  - Be aware this manual describes how to respond to ventilator, but it does NOT tell you how to respond to the patient.
  - While the ventilator is in use, an alternative means of ventilation should always be available in the event of a ventilator problem. This is particularly true for ventilator-dependent patients. Supplementary observation, appropriate for the patient's condition, is also recommended.
  - To ensure that ventilation continues uninterrupted, ensure alternative power sources are available (AC power source, extra batteries, or an auxiliary DC car adapter). Be prepared for the possibility of power failure by having an alternative means of ventilation ready for use—particularly for ventilator-dependent patients.
  - Do not allow a patient to remain connected to the ventilator when ventilation is stopped, because a substantial quantity of exhalation gas, primarily carbon dioxide, may be inhaled by the patient. In some circumstances, inhaling carbon dioxide may lead to under-ventilation, suffocation, and serious injury or death.
  - The ventilator must not be used with flammable anesthetic substances.
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- Do not start ventilation until you ensure that the device is suitably assembled, that the air inlet filter is properly installed and is not obstructed, and that there is proper clearance all around the unit. Also ensure that the patient circuit is suitably connected to both the ventilator and the patient and that the patient circuit, including all hoses, is not damaged or obstructed.
- A ventilator-dependent patient should always be monitored by trained and competent medical personnel. Ensure that the patient's caregiver is able and prepared to take suitable action in the event the ventilator identifies an alarmed condition or experiences a problem.
- Do not use a patient circuit with a leak accessory for ventilator-dependent patients.
- Before dispensing the ventilator to caregivers or the patient for home use, ensure the Locking Key is activated so that critical ventilator settings are not modified.
- Do not perform ventilator alarm tests while the patient is connected to the ventilator. Provide the patient with an alternate means of ventilation before conducting these tests.
- Verify the functionality of the alarm conditions before connecting the patient to the ventilator. Refer to chapter F, "Alarms Tests"
- If the ventilator fails the alarm tests or if you cannot complete the tests, refer to chapter 5.8, "Troubleshooting" or call your equipment supplier or Covidien.
- When an alarm condition is triggered, or there is evidence of a patient-ventilator fault or problem, examine the patient first before examining the ventilator.
- A continuous alarm condition will be activated if the ventilator power switch is turned off while ventilation is in progress. When the power switch is turned back on again, ventilation will resume without having to press the VENTILATION ON/OFF button.
- To reduce the risk of infection, wash your hands thoroughly before and after handling the ventilator or its accessories.
- A patient treated by mechanical ventilation is highly vulnerable to the risks of infection. Dirty or contaminated equipment is a potential source of infection. Clean the ventilator and its accessories regularly and systematically before and after each use and following any maintenance procedure to reduce the risks of infection. The use of a bacterial filter at the ventilator's outlet—or both ports if a double-limb circuit is used—is recommended. Refer to chapter 9, "Cleaning".
- Handle the ventilator with care during and after use, particularly when ambient temperatures are high. Some ventilator surfaces may become hot, even if safety specifications are not exceeded.



#### Warnings Regarding Installation and Environment of Use

- Even though the Puritan Bennett™ 560 Ventilator meets current safety standards, the internal Lithium-ion battery of the device exceeds the 100Wh threshold and is therefore considered to be Dangerous Goods (DG) Class 9 – Miscellaneous, when transported in commerce. As such, the Puritan Bennett™ 560 Ventilator and/or the associated Lithium-ion battery are subject to strict transport conditions under the Dangerous Goods Regulation for air transport (IATA: International Air Transport Association), International Maritime Dangerous Goods code for sea and the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) for Europe. Private individuals who transport the device are excluded from these regulations although for air transport some requirements apply. For air transport; the Puritan Bennett™ 560 Ventilator is permitted as checked-in or carry-on baggage. Two spare batteries per person may be taken on board as carry-on luggage only, with the prior approval of the airline. This classification and regulatory requirements may vary depending upon the country and mode of transport. Therefore it is recommended that users verify with the carrier / airline as to which measures to take before the voyage.
- To minimise the risk of damage, you must use the ventilator's Dual Bag to transport the ventilator. See Table H-1, [List of Consumables and Accessories](#)
- Regularly clean the ventilator's Dual Bag according to manufacturer's recommendations.
- The ventilator should never be immersed in any liquid, and any liquid on the surface of the device should be wiped away immediately.

- To avoid damage to the ventilator, in particular the batteries or electrical components, fluids must not be allowed to enter the device, particularly through the air inlet filter or the cooling apertures located in the side, rear, and bottom panels of the ventilator.
- To ensure correct and lasting operation of the device, ensure that the ventilator is installed and operated in the environmental conditions recommended in Appendix B, "Specifications."
- Do not leave power cables lying on the ground where they may pose a hazard.
- Do not operate the ventilator in direct sunlight, near heat sources, outdoors, or near installations where liquid may pose a risk without first providing adequate protection for the device.
- Avoid using the ventilator, if possible, in dusty environments. Dusty environments may require more vigilant monitoring, cleaning, and/or replacement of air intake and other filters.
- Ensure that the ventilator's immediate surroundings allow for the proper operational connection of the device without folding, pinching, or damaging any of the required cables or tubes, and that the connection of the to the patient provides for a secure, comfortable fit.
- Place the ventilator in a safe place when ventilating and according to the recommendations in this manual.
- Do not place the ventilator in a position where a child can reach it or in any position that might cause it to fall on the patient or someone else.
- To ensure correct and lasting operation of the ventilator, ensure that its air circulation holes (main inlet or cooling) are never obstructed. Place the device in an area where air can freely circulate around the ventilator and avoid installing it near floating fabrics, such as curtains.
- If the ventilator has been transported or stored at a temperature that differs more than  $\pm 20^{\circ}\text{C}$  ( $\pm 36^{\circ}\text{F}$ ) from the temperature in which it will be operating, the ventilator should be allowed to stabilise in its operating environment for at least two (2) hours prior to use.
- If the ambient temperature where the device is operated is greater than  $35^{\circ}\text{C}$  ( $95^{\circ}\text{F}$ ), the flow supplied at the device outlet may exceed  $41^{\circ}\text{C}$  ( $106^{\circ}\text{F}$ ). This may lead to undesirable side effects for the patient. To avoid injury to the patient move the patient and the ventilator to a cooler location. For more information, contact Covidien.
- The default setting for altitude compensation is YES. Altitude compensation should always be set to YES for accurate volume delivery calculations at all elevations.
- To reduce the risk of a fire hazard, keep matches, lighted cigarettes, and all other sources of ignition (such as flammable anesthetics and/or heaters) away from the ventilator and oxygen hoses.
- Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. If necessary, replace the filter before the recommended replacement period is over (see chapter 10, "Routine Maintenance"). This is particularly important when the ventilator is installed on a wheelchair, because environmental conditions may cause the filter to become dirty more rapidly.
- Handle the ventilator with care during and after use, particularly when ambient temperatures are high. Some ventilator surfaces may become hot, even if safety specifications are not exceeded.



### Warnings Regarding Electrical Power Supplies

- Never connect your ventilator to an electrical outlet controlled by a wall switch because the power may be inadvertently turned off.
- The operator should connect the ventilator to an AC power source whenever available, for safer operation.
- The maximum recommended shelf life of the internal battery is two (2) years. Do not use a battery that has been stored for two years prior to its first use.
- Periodic recharging is important to help maximize useful life of the battery. Do not store the internal battery for extended periods, without recharging, as this may reduce the maximum life.

- For the AC (“mains”) power cable to be properly secured, the attachment located on the power cable must be fitted into the power cable holder incorporated in the battery access cover and located under the AC (mains) power socket. Refer to section 6.2, “Connecting to External AC Power”.
- The power supply to which the ventilator is connected (both AC and DC) must comply with all applicable standards and provide electrical power corresponding to the voltage characteristics inscribed on the rear of the ventilator to ensure correct operation. Refer also to the electrical specifications found in [Appendix B, “Specifications”](#).
- Ensure that the ventilator’s internal battery is fully charged before connecting the ventilator to an external DC power source. Powering the ventilator using an external 12– 30 VDC power source (via the DC power cable) does not enable its internal battery to recharge.
- Due to its limited internal battery’s reserve capacity, the ventilator should only be operated on the internal battery when no other power source is available. Ensure that the internal battery never becomes fully discharged.
- When using a car auxiliary adapter (cigarette lighter) ensure the car has been started prior to plugging in the ventilator’s DC adapter. Refer to chapter 6.3, “Connecting to an External DC Power Source”
- Even if the “INTERNAL BATTERY” charging indicator is off, charging of the battery may sometimes be incomplete if the ambient temperature is above 40 °C (104 °F) because of the battery’s internal heat safety device.
- When the “LOW BATTERY” alarm is triggered, immediately connect the ventilator to an AC power supply to maintain ventilation and recharge the internal battery.
- Batteries should be disposed of according to environmental legislation in your country and locality.
- Never expose any batteries to direct flame.
- Ensure that the AC power cable is in perfect condition and not compressed. The device should not be turned on if the AC power cable is damaged.



#### Warnings Regarding Hoses and Accessories

- The ventilator must not use, nor be connected to, any anti-static or electrically conductive hoses, tubing, or conduits.
- Minimum and maximum VTE alarm parameters must be properly set to warn in the event of patient disconnection.
- Before opening the packaging for the Patient Circuit, ensure that no damage is evident to the packaging or its contents. Do not use if evidence of damage exists.
- The patient circuit should not be changed during ventilation.
- On a DAILY basis, inspect the patient circuit to ensure that it shows no signs of damage, is properly connected, and is operating correctly without leakage.
- Single Use accessories should not be reused.
- The exhalation block is intended for single use by a single patient ②. It may periodically be cleaned, but it cannot be disinfected or sterilised. To maintain good measurement quality when used continuously, clean the exhalation block periodically (refer to section 9.3, “Cleaning the Exhalation Block”). The exhalation block should be changed every 4 months and cannot be reused with any other patient.
- During invasive ventilation (when an artificial airway bypasses the patient’s upper respiratory system), the patient’s upper respiratory system cannot humidify the incoming gas. For this reason, the use of a humidifier, to minimise drying of the patient’s airway and subsequent irritation and discomfort, must be used.
- If exhaled tidal volume measurements are required to ensure correct patient ventilation a double limb patient circuit configuration must be used in order to detect leaks. In this case, both the minimum and maximum VTE alarm parameters must be properly set to warn in the event of patient disconnection.

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- Failing to replace a dirty air inlet filter, or operating the ventilator without a filter, may cause serious damage to the ventilator.
  - Before cleaning the ventilator, first disconnect the ventilator and the patient circuit.
  - If the ventilator is used indoors, the condition of the air inlet filter should be checked monthly. If the ventilator is used outdoors or in a dusty environment, the filter should be checked weekly and replaced as necessary.
  - The air inlet filter is not reusable; do not attempt to wash, clean, or reuse it.
  - The patient circuit should always be positioned to avoid hindering the patient's movements, to prevent accidental disconnection or leakage, and to minimise the risk of patient strangulation.
  - For pediatric use, ensure that the patient circuit type fits, and, in all respects, is suitable for use with a child. Use a pediatric circuit for patients that weigh under 53 lb. (23 kg). To ensure proper performance of the ventilator, See Table H-2, [List of Circuits](#), on page H-2, for a list of recommended patient circuits.
  - Resistance of the exhalation valve and accessories (water traps, filters, HMEs etc) must be as low as possible.
  - Adding attachments to the ventilator breathing system can cause the pressure during exhalation at the patient connection port to increase.
  - The exhalation valve must allow rapid discharge of the circuit pressure. Ensure that the exhalation valve is always clean and its evacuation aperture (exhaust port) is never obstructed.
  - Users must always possess an additional breathing circuit and exhalation valve while using the Puritan Bennett™ 560 Ventilator.
  - Always ensure that the humidification device is positioned lower than both the ventilator and the patient. Use water traps, if necessary, to limit water in the patient circuit and periodically empty these water traps.
  - If a heated humidifier is used, you should always monitor the temperature of the gas delivered to the patient. Gas delivered from the ventilator that becomes too hot may burn the patient's airway.
  - Adding accessories to the ventilator breathing circuit, such as a humidifier and water trap(s), may result in a decrease in tidal volume delivered to the patient due to the added compressible volume of the accessory. Always assure that the patient is receiving the appropriate inspired volume when altering the breathing circuit configuration.
  - The level of inspiratory resistance of the circuit and accessories (bacteria filter, humidifier, HMEs etc) must be as low as possible. Settings—particularly the PATIENT DISCONNECTION alarm, maximum inspired volume (Max VTI), and minimum inspired volume (Min VTI) settings—must be periodically adjusted according to changes in the patient circuit resistance—especially when filters are replaced.
  - To ensure proper performance of the ventilator, use a patient circuit recommended by Puritan Bennett in this manual; refer to chapter 6, [“Installation and Assembly”](#) and [Appendix H, “Parts and Accessories”](#). The total specified length of the patient circuit tubing as measured from the ventilator outlet to the ventilator inlet is 1.1 metres (3.6 feet) to 2.0 metres (6.6 feet). The tubing must conform to all applicable standards and must be fitted with Ø 22 mm terminals that also conform to all applicable standards. Ensure that both the length and the internal volume of the patient circuit are appropriate for the tidal volume: a corrugated tube of Ø 22 mm for adult patients, and a corrugated tube of Ø 15 mm for pediatric patients with a tidal volume lower than 200 ml.
  - To ensure proper performance of the ventilator, use only accessories (including oxygen accessories) approved and recommended by Covidien. See [Appendix H, “Parts and Accessories”](#) or contact your customer services.
  - When using non-invasive ventilation (NIV) without an exhalation valve, use a vented nose or face mask or a non vented combined with a leak accessory. When using non-invasive ventilation (NIV) with an exhalation valve, use a non-vented mask.
  - Before using the Nurse Call system, ensure that its connections are secure and it operates properly. For more information, contact Covidien.
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- To connect the ventilator to a Nurse Call device, contact Covidien to check the ventilator's compatibility with the Nurse Call device and order a suitable connection cable.
- Do not use Nurse Call devices that operate based on the closure of an electrical circuit, because the devices often do not take into account possible cable disconnection or a total loss of power. Ensure that the Nurse Call device is always connected to the ventilator.



### Warnings Regarding Settings:

- Before starting ventilation, always verify that all settings are properly set in accordance with the required prescription.
- Before starting ventilation, ensure that the device is properly assembled and that the air inlet, cooling vents, and alarm sound diffusion holes are not obstructed. Ensure also that the patient circuit is of the proper configuration (double or single limb), properly connected to the ventilator, and that the circuit hoses are neither damaged nor compressed and contain no obstructions or foreign bodies.
- The CPAP mode does not provide a set respiratory rate. Do not use this mode for ventilator-dependent patients.
- Do not allow a patient to remain connected to the ventilator when ventilation is stopped, because a substantial quantity of exhalation gas, primarily carbon dioxide, may be inhaled by the patient.
- Alarm volume should be adjusted with respect to the ventilator's operating environment and so that the patient's caretakers can hear the alarms. The audible alarm vents located at the front of the device should never be obstructed. The alarm can be paused with the Alarm Pause function by pressing the ALARM CONTROL key twice once the alarm has been declared.
- Ensure that the I Sens setting is not set to OFF when ventilating patients capable of triggering spontaneous breaths.
- Monitor the patient's state of health in order to ensure that the ventilator's settings are always suited to the patient's current physiological requirements.
- In adult or pediatric use ensure that the adjusted tidal volume is compatible with the needs of the patient.
- When changing the mode during ventilation, significant transitions of pressure, flow or cycling rate might occur, depending on the difference between the modes. Before setting the new mode, first ensure that the settings between the different modes are compatible. This reduces the risk of discomfort and harm to the patient.
- Do not conduct the ventilator alarm test while the patient is connected to the ventilator. Switch the patient to an alternate means of ventilation before testing.
- The setting of the Low PIP alarm must be adjusted for the patient, but must also be set high enough to allow the PATIENT DISCONNECTION alarm to trigger properly. Perform the Low Pressure Test (refer to section F.1, "Low Pressure Test") to ensure the Low PIP alarm is properly set.
- If APNEA TIME is set to a value higher than 60/Control R then the APNEA alarm will not activate.
- If an APNEA alarm is required, set the APNEA setting to YES in the Preferences Menu.
- The Apnea Alarm should be set to YES for ventilator dependant patients.
- Setting Alarm limits to extreme values can cause the ventilator alarms to malfunction.
- Ensure the Insp Time setting is compatible with the physiological requirements of the patient.
- Adjustable alarms should not be systematically cancelled; instead, they should be adjusted according to the needs and condition of the patient.
- A continuous alarm condition will be activated if the ventilator power switch is turned off while ventilation is in progress. When the power switch is turned back on again, the ventilation will resume without having to press the VENTILATION ON/OFF button.

- In the SIMV mode the use of a double limb circuit is recommended. The Min VTE setting should remain active in the event that pressure losses are present on the patient circuit downstream from the proximal pressure link. In such cases the "PATIENT DISCONNECTION" alarm would not be systematically activated in case of a disconnection of the circuit.
- The inspiration trigger threshold should be carefully modified in order to avoid the risk of false triggering or "autotriggering" of the ventilator. For example, Level 1P, the most sensitive mode, is recommended for pediatric use. However, for an adult, this setting may result in autotriggering.
- The sound level of the alarms should be adjusted according to the installation environment and the size of the area monitored by the patient's caregiver. Ensure that the alarm sound apertures at the front of the device are never obstructed.



#### Warnings Regarding USB Memory Device

- Always verify the file ID before using a USB memory device to transfer data between the ventilator and a PC.



#### Warnings Regarding Maintenance

- Never use a ventilator or any components or accessories that appear to be damaged. If any signs of damage are evident, contact your equipment supplier or Covidien.
- To ensure proper servicing and avoid the possibility of physical injury to personnel or damage to the ventilator, only personnel authorised and qualified by Covidien should attempt to service or make authorised modifications to the Puritan Bennett™ 560 Ventilator.
- If you cannot determine the cause of a problem with your ventilator, contact your equipment supplier. Do not use the ventilator until the problem has been corrected.
- To ensure proper performance of the ventilator, the preventative maintenance schedule should be followed. For further information contact Covidien.
- On a daily basis, ensure the proper connection and operation of the patient circuit.
- If a problem with the ventilator is suspected, FIRST CHECK THAT THE PATIENT IS NOT IN DANGER. If necessary, remove the patient from the ventilator and provide an alternative means of ventilation.
- After assembling, cleaning, or reassembling the patient circuit, and on a daily basis, inspect the hoses and other components to ensure that there are no cracks or leaks and that all connections are secure.
- Use all cleaning solutions and products with caution. Read and follow the instructions associated with the cleaning solutions you use to clean your ventilator. Use only those solutions listed in [Table 9-1](#).
- Never use a liquid cleaner inside the patient circuit, or on any component of a gas pathway. Clean the patient circuit only as specified by the manufacturer's instructions.
- Do not attempt to open, repair or otherwise service the ventilator yourself. Doing so might endanger the patient, damage the ventilator, and/or void your warranty. Only personnel authorised and qualified by Covidien should repair, open or service the ventilator.
- If the ventilator is damaged or its external housing is not correctly closed or it behaves in a way that is not described in this manual (excessive noise, heat emission, unusual odor, alarms not triggered during the start-up procedure), the oxygen and power supplies should be disconnected and use of the device stopped immediately.
- The exhalation block is intended for single use by a single patient ②. It may periodically be cleaned, but it cannot be disinfected or sterilised. To maintain good measurement quality when used continuously, clean the exhalation block periodically (refer to section 9.3, "[Cleaning the Exhalation Block](#)"). The exhalation block should be changed every 4 months and cannot be reused with any other patient.
- Ensure that the exhalation block is completely dried after cleaning and prior to use.

- When an exhalation block is set up, each time it is removed, or after installing a new exhalation block on the machine, it is essential that the exhalation flow sensor be recalibrated before the exhalation block is used. Refer to section 10.1, “Calibrating the Exhalation Flow Sensor”.
- The patient circuit is intended for single use by a single patient ② and should be changed according to the manufacturer’s recommendations and according to the patient circuit lifetime. Refer to the instructions for use supplied by the manufacturer of the patient circuit (included with the ventilator) and chapter 6, “Installation and Assembly”.
- A patient treated by mechanical ventilation is highly vulnerable to the risks of infection. Dirty or contaminated equipment is a potential source of infection. Clean the ventilator and its accessories regularly and systematically before and after each use and following any maintenance procedure to reduce the risks of infection. The use of a bacterial filter at the ventilator’s outlet—or both ports if a double-limb circuit is used—is recommended. Refer to chapter 9, “Cleaning”.
- Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. If necessary, replace the filter before the recommended replacement period is over (see chapter 10, “Routine Maintenance”). This is particularly important when the ventilator is installed on a wheelchair, because environmental conditions may cause the filter to become dirty more rapidly.
- For environmental protection, the ventilator and its components, whatever their respective conditions of operation, cannot be disposed of with household waste and must be submitted for suitable selective collection and possible recycling. Observe all applicable regulations when disposing of the ventilator and any of its components.
- If the device is damaged, its external housing is not correctly closed, or it behaves in a way that is not described in this manual (excessive noise, heat emission, unusual odour, alarms not triggered during the start-up procedure), the oxygen and power supplies should be disconnected and use of the device stopped immediately.
- Before using the ventilator’s internal battery, ensure that the battery is fully charged and that the charge holds. Back up ventilators or those in storage should be connected to an AC power source to protect the integrity of the battery.
- The maximum recommended shelf life of the internal battery is two (2) years. Do not use a battery that has been stored for two years prior to its first use. Periodic recharging is important to help maximize useful life of the battery. Do not store the internal battery for extended periods, without recharging, as this may reduce the maximum life.
- To connect the ventilator to an external power source, first ensure the ventilator’s I/O switch is off (O). Then, connect the desired power cable to the ventilator. Finally, connect the power cable to the external power source.
- To disconnect the ventilator from an external power source, first power-down the ventilator. Then, disconnect the power cable from the external power source and, finally, the ventilator.
- Connect the external DC power source by first connecting the power cable to the ventilator and then to the external DC source. Follow the reverse procedure to disconnect the device from the external DC power source.
- Connect the external electrical power source by first connecting the power cable to the ventilator and then to the external power source. Follow the reverse procedure to disconnect the device from electrical power sources.



### Warnings Regarding Oxygen

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- The ventilator must not be used with flammable anesthetic substances.
  - Oxygen therapy for patients with respiratory failure is a common and effective medical prescription. However, be aware that inappropriate oxygen use may potentially lead to serious complications, including, but not limited to, patient injury.
  - Strictly follow the instructions provided in section 6.8.2, “Connecting the Oxygen Supply”, which include the use of a flow regulator and special oxygen connector.
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- To avoid injury to the patient and/or possible damage to the ventilator: before connecting the ventilator to the oxygen supply, ensure a flow meter (flow regulator) is connected to the ventilator to regulate the oxygen supply to the required specification.
- The Puritan Bennett™ 560 Ventilator can be used with an optional oxygen analyser with minimum and maximum concentration alarms. Always measure the delivered oxygen with a calibrated oxygen analyser (FiO<sub>2</sub> kit) that features a minimum and maximum concentration alarm in order to ensure that the prescribed oxygen concentration is delivered to the patient.
- The Puritan Bennett™ 560 Ventilator is designed to deliver a percentage of oxygen equal or lower than 50%. Do not exceed this value as this may cause the ventilator to malfunction and put the patient at risk.
- Ensure that the oxygen supply pressure to the machine never exceeds 7 psi (50 kPa) or a flow of 15 lpm. Refer to [Table B-8](#) on page B-3 for volume and sensitivity tolerances.
- In the event of an oxygen leak, shut down the supply of oxygen at its source. In addition, remove and/or keep any incandescent source away from the device, which may be enriched with oxygen. Circulate fresh air into the room to bring the oxygen level down to normal.
- The hose connecting the ventilator to the oxygen source must be designed exclusively for use with medical-grade oxygen. Under no circumstances should the oxygen hose be modified by the user. In addition, the hose must be installed without the use of lubricants.
- Ensure that the only gas supplied to the ventilator through the dedicated oxygen supply connector is medical-grade oxygen.
- The coupler must not remain connected to the oxygen connector unless it also connected to a leak-proof, external oxygen gas source. When an oxygen supply is not being used with the ventilator, disconnect the oxygen source completely from the ventilator.
- To prevent any interference with the internal sensors of the ventilator, do not install a humidifier upstream of the ventilator.
- To ensure stability, when the Puritan Bennett™ 560 Ventilator is mounted on a cart, the weight of the oxygen bottle should not exceed 14 kg (30 lbs).
- The oxygen supply hose ages even when it is not in use and should be replaced periodically. The expiration date may be located on the back of the hose end-piece.
- The oxygen supply must be regulated using a flow meter connected to the source gas outlet.
- The oxygen supply must be shut off when ventilation is interrupted. Before disconnecting the oxygen hose, allow the ventilator to continue for a few cycles without oxygen to flush the patient circuit of excess oxygen.
- Before connecting the oxygen supply, ensure that the stud on the oxygen connector is protruding outwards.
- Inspect the oxygen coupler before use to ensure it has its black O-ring attached and in good condition. Do not use an oxygen coupler with a missing, damaged, or worn O-ring.














### Warnings Regarding Electromagnetic Interference












- The Puritan Bennett™ 560 requires special precautions for electromagnetic compatibility and should be installed and started according to the recommendations found in [Appendix B, "Specifications."](#) In particular, the use of nearby mobile and portable communications equipment using radio frequencies, such as mobile telephones or other systems exceeding the levels set in the IEC 60601-1-2 standard, may affect its operation. Refer to section [B.10, "Manufacturer's Declaration"](#).
- The use of any accessory other than those specified, with the exception of the power supplies or cables sold by Covidien, may lead to an increase in electromagnetic emissions or a decrease in the equipment protection against electromagnetic emissions. If the ventilator is used adjacent to such accessories or stacked with such devices, the ventilator's performance should be monitored to verify normal operation.

## 1.3 Symbols and Markings















**Table 1-1.** Ventilator Symbols

Symbols	Descriptions
	It is essential to read, understand, and follow these instructions before using the Puritan Bennett™ 560 Ventilator (ISO 7000-0434A). This symbol appears on the ventilator's back panel, see <a href="#">Table 1-2</a> , item 5.
	Type BF applied part (IEC 60417-5333). A regulatory standard classification for protection against electrical shock for the part of the device that contacts the patient. This symbol appears on the ventilator's back panel; see <a href="#">Table 1-2</a> , item 5.
	Direct current, DC (IEC 60417-5031). This symbol appears on the ventilator's back panel; see <a href="#">Figure 1-4</a> , item 9.
	Alternating current, AC (IEC 60417-5032). This symbol appears on the ventilator's back panel and keyboard; see <a href="#">Figure 1-4</a> , item 8, and <a href="#">Figure 2-2</a> on page 2-5, item 10.
	Internal Battery. This symbol appears on the ventilator's keyboard; see <a href="#">Figure 2-3</a> on page 2-6, item 10.
	Insulation class II equipment (IEC 60417-5172). A regulatory standard classification for protection against electric shock. Class II equipment relies on double insulation rather than protective earthing. This symbol appears on the ventilator's back panel; see <a href="#">Table 1-2</a> , item 5.
IP31	Index of Protection rating for the ventilator's enclosure, defined in IEC 60529 (BSEN60529:1991). The first digit, 3, indicates protection against the intrusion of small foreign bodies (including fingers, tools, wires, etc. with a diameter greater than 2.5 mm) into the ventilator. The second digit, 1, indicates protection against water dripping or falling vertically, as well as an environment featuring water vapour condensation and/or light rain. This rating appears on the ventilator's back panel; see <a href="#">Table 1-2</a> , item 5.
	CSA – Canadian Standards Association. This symbol appears on the ventilator's back panel; see <a href="#">Table 1-2</a> , item 5.
	CE - Conformity European Signifies compliance with the medical device directive 2007/47/EC. This symbol appears on the ventilator's back panel; see <a href="#">Table 1-2</a> , item 5.
	This symbol appears on the ventilator's front panel UP/UNFREEZE key; see <a href="#">Figure 2-3</a> on page 2-6, item 4. This key is used to: move the LCD display's cursor upwards, line-by-line; increase the value of displayed and selected parameter settings; restart ("unfreeze") waveforms tracing.
	This symbol appears on the ventilator's front panel DOWN/FREEZE key; see <a href="#">Figure 2-3</a> on page 2-6, item 6. This key is used to: move the LCD display's cursor downwards, line-by-line; decrease the value of displayed and selected parameter settings; stop ("freeze") waveforms tracing.
	This symbol appears on the ventilator's front panel ENTER key; see <a href="#">Figure 2-3</a> on page 2-6, item 5. This key is used to confirm command actions.














**Table 1-1.** Ventilator Symbols

Symbols	Descriptions
	This symbol appears on the ventilator's front panel <b>ALARM CONTROL</b> key; see <a href="#">Figure 2-3</a> on page 2-6, item 3. This key is used to: cancel the audible portion of alarms for 60 seconds at a time; cancel an alarm. For more information, refer to section <a href="#">F</a> , "Alarms Tests."
	This symbol appears on the ventilator's front panel MENU key; see <a href="#">Figure 2-3</a> on page 2-6, item 7. This key is used to access the ventilator's menus via the ventilator's front panel LCD display.
	This symbol (IEC 60417– 5009) appears on the ventilator's front panel VENTILATION ON/OFF button; see <a href="#">Figure 2-3</a> on page 2-6, item 8. This key is used to Start and Stop ventilation.
	To patient port. This symbol appears on the front right of the ventilator, adjacent to the To Patient port; see <a href="#">Figure 1-1</a> on page 1-15, item 1.
	From patient-port (double-limb option). This symbol appears on the front-left of the ventilator, adjacent to the From Patient port; see <a href="#">Figure 1-1</a> on page 1-15, item 4.
	Patient proximal pressure port. This symbol appears on the front right of the ventilator, adjacent to the From Patient port; see <a href="#">Figure 1-1</a> on page 1-15 and <a href="#">Figure 1-4</a> on page 1-17, item 3.
	Exhalation valve pilot port. This symbol appears on the front right of the ventilator, adjacent to the To Patient port indicating the connection of the tubing between the patient circuit exhalation valve; see <a href="#">Figure 1-1</a> on page 1-15, and <a href="#">Figure 1-4</a> on page 1-17, item 3
	Oxygen inlet. This marking appears on the back panel of the ventilator, adjacent to the oxygen inlet port; see <a href="#">Figure 1-3</a> on page 1-16, item 2.
	Nurse Call connector. This symbol appears on the back panel of the ventilator, adjacent to the nurse call connector; see <a href="#">Figure 1-3</a> on page 1-16, item 2.
	Switch in "Off" position (IEC 60417-5008). This symbol appears on the I/O (power on/off) switch on the back panel of the ventilator to indicate the switch's "Off" position. See <a href="#">Figure 2-2</a> on page 2-5, item 2.
	Switch in "On" position (IEC 60417-5007). This symbol appears on the I/O (power on/off) switch on the back panel of the ventilator to indicate the switch's "On" position. See <a href="#">Figure 2-2</a> on page 2-5, item 2.
	Software Lock Enabled. This symbol appears on the upper-left of the ventilator's LCD display when the keyboard Locking Key is enabled; see section <a href="#">7.8</a> , "Locking the Control Panel".
	Internal Battery. This symbol appears on the top-center of ventilator's LCD display to indicate that the ventilator is being powered by its internal battery. See <a href="#">Figure 2-4</a> on page 2-7, item 1 and refer to chapter <a href="#">8</a> , "Internal Battery", for more information.
	Pressure rise times (inspiratory phase) parameter. These symbols appear on the ventilation mode menu screens. For more information, refer to chapter <a href="#">3</a> , "Operating Parameters". In pressure ventilation modes, you can select one of four rise times with setting 1 representing the fastest rise time and setting 4 representing the slowest.

**Table 1-1.** Ventilator Symbols

Symbols	Descriptions
	Flow shape ("flow distribution shape", inspiratory phase) parameter. These symbols appear on the ventilation mode menu screens; selectable for V A/C mode only. For more information, refer to chapter 3, "Operating Parameters". In volume ventilation mode you can select between Square (SQ), Descending (D) or Sinusoidal (S) flow patterns.
	Selected line (filled square). When making menu choices, this graphic indicates the line on which the cursor is currently positioned. See Figure 7-11, <a href="#">Selecting the Preferences Menu</a> , on page 7-9.
	Non-selected line (empty square). When making menu choices, this graphic indicates a line on which the cursor is currently not positioned.
	Locked parameter line. When making menu choices, this graphic indicates a line that cannot be selected (the Locking Key is enabled).
	Active parameter line. When making menu choices, this graphic indicates that the current parameter is selected and can be changed. See chapter 7, "Operating Procedures".
	Inspiratory Effort Detected. This symbol appears in the front panel display's Status window when the patient triggers a breath.
	Parameter adjustment bar. This graphic shows the current setting for parameters such as display contrast and alarm volume in the Preferences menu. Refer to section 7.3, "Preferences Menu Parameters".
	WEEE (Waste Electrical and Electronic Equipment). This symbol means that this product must not be disposed of with household waste. Observe local ordinances for proper disposal. Refer to <a href="#">Table 1-2</a> , item 5.
	Year of Manufacture.
	Manufacturer.
	Audio Paused. This symbol means the sounding of audible alarms is currently disabled. For more information, refer to section 5.4, "Silencing the Audible Portion of Alarms".
	Alarm Paused (reset/cancelled). This symbol means one or more alarms have been paused, or reset/cancelled. For more information, refer to section 5.5, "Pausing/Resetting Alarms".
	Apnea Alarm Deactivated. This symbol means that the Apnea Alarm has been deactivated. For more information, refer to section 5.5, "Pausing/Resetting Alarms".
	Exhalation Valve detected. This symbol means that an exhalation valve has been detected during ventilation.

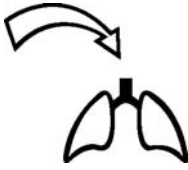

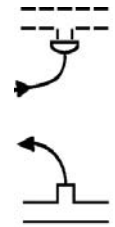

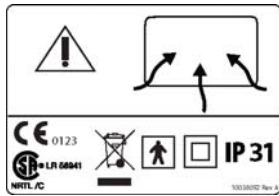
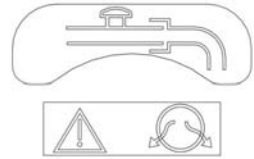
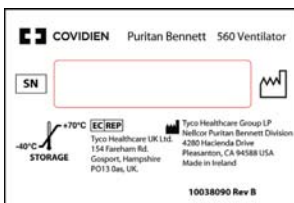
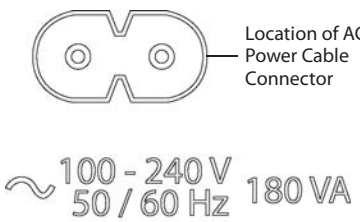
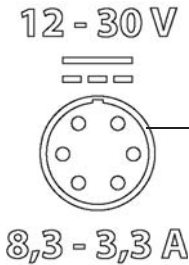
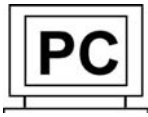


**Table 1-1.** Ventilator Symbols

Symbols	Descriptions
	No Exhalation Valve detected. This symbol means that no exhalation valve has been detected during ventilation.
	Single patient use only (ISO 7000-1051). This symbol means that the labeled device is for use by a single patient only.
	Freeze Waveforms. This symbol means the tracing of patient pressure and flow waveforms is currently paused or “frozen.” For more information, refer to section 4.3, “Waveform Display”.
	Follow instructions for use (ISO 7000-1641). This symbol directs the user to observe and adhere to the instructions contained in the product’s user manuals.
	USB port. This symbol indicates a communications port for interfacing with a USB connector. See <a href="#">Figure 2-2</a> , item 11.
	PC connector. This symbol indicates a port that can be used by authorised Puritan Bennett product service personnel or Covidien service personnel for software maintenance. See <a href="#">Figure 2-2</a> , item 10.
	Atmospheric pressure limitation.
	Humidity limitations.
	Temperature limitations.
	Fragile.
	Keep dry.
	Keep away from direct sunlight.
	This side up.

## 1.4 Labels / Identification and Instruction Information

Various labels or specific markings are affixed to the ventilator that describe precautions to be taken for the correct use of the ventilator and contribute to the traceability of the product. Refer to [Table 1-2](#) and the figures on the following pages for illustrations of these labels and markings and their locations on the ventilator. Use the item numbers in the following tables to locate the labels in [Figure 1-1](#) to [Figure 1-4](#).

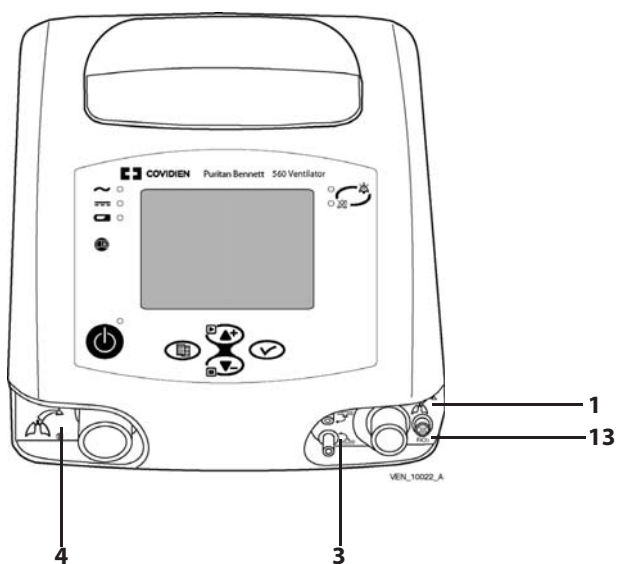
**Table 1-2.** Ventilator Labels and Markings

 <p><b>1. Patient Gas Inlet Label</b> (Figure 1-1, Figure 1-4)</p>	 <p><b>2. Oxygen Inlet Marking and Label</b> (Figure 1-3)</p>	 <p><b>3. Exhalation Valve and Patient Pressure Connection Label</b> (Figure 1-1, Figure 1-4)</p>
 <p><b>4. From Patient Port, Exhalation Limb Connection of Patient Circuit – Single Use Exhalation Block Label</b>  (Figure 1-1, Figure 1-2, Figure 1-4)</p>	 <p><b>5. Air Inlet Label</b> (Figure 1-3)</p>	 <p><b>6. Exhaled Gas Outlet Label</b> (Figure 1-2)</p>
 <p><b>7. Identification Label</b> (Figure 1-4)</p>	 <p><b>8. AC Power (Mains) Cable Connector Marking</b> (Figure 1-3)</p>	 <p><b>9. External Cable Connector Marking</b> (Figure 1-3)</p>
 <p><b>10. PC Connection marking</b> (Figure 1-3)</p>	 <p><b>11. USB Port marking</b> (Figure 1-3)</p>	 <p><b>12. Nurse Call Cable Connector Marking</b> (Figure 1-3)</p>

**Table 1-2.** Ventilator Labels and Markings (Continued)

 <p><b>13. FiO<sub>2</sub> Label</b> (Figure 1-1, Figure 1-4)</p>		
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Note: The item number callouts in the following figures refer to those listed in [Table 1-2](#).



**Figure 1-1.** Locations of Labels – Top-Front View

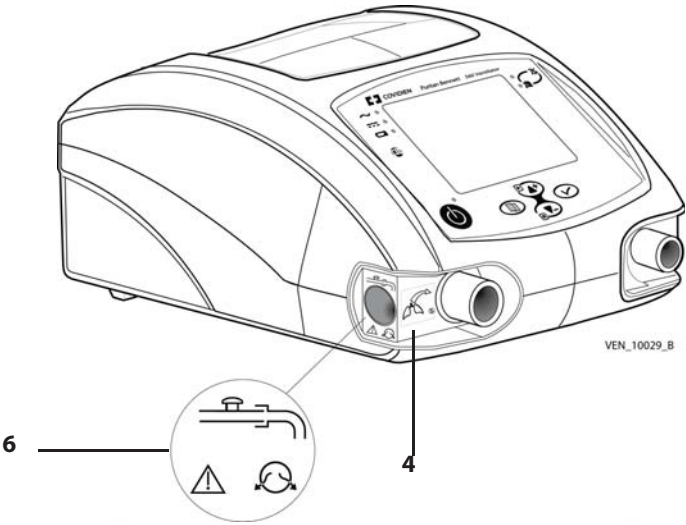


Figure 1-2. Locations of Labels – Front-Left View

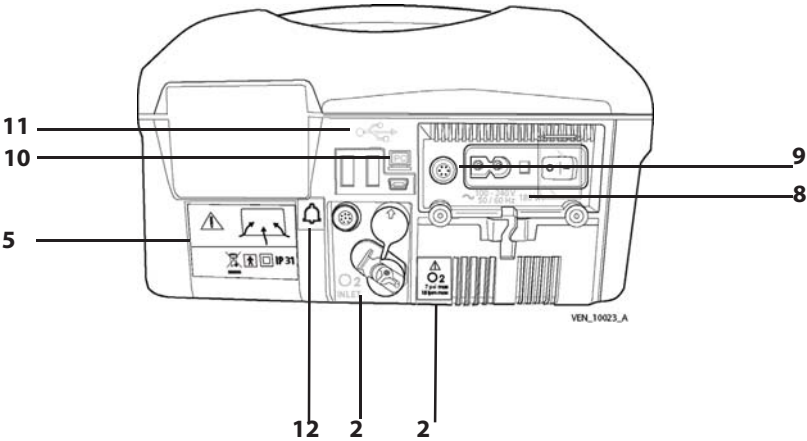
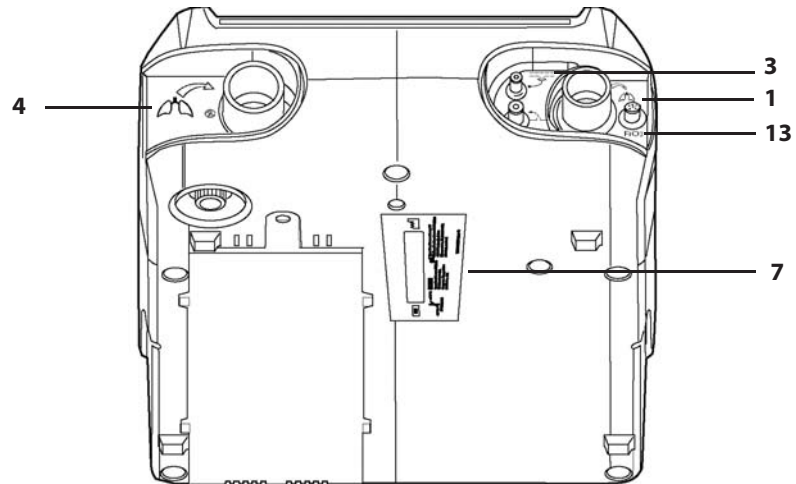


Figure 1-3. Location of Labels and Markings – Rear View



**Figure 1-4.** Location of Labels – Bottom View

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# 2 Ventilator Overview

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## 2.1 Indications for Use

The Puritan Bennett™ 560 Ventilator is indicated for the continuous or intermittent mechanical ventilatory support of patients weighing at least 11 lb (5 kg) who require mechanical ventilation. The ventilator is a restricted medical device intended for use by qualified, trained personnel under the direction of a doctor. It is essential to read, understand, and follow these instructions before using the Puritan Bennett™ 560 Ventilator.

### Target Patients

Specifically, the ventilator is applicable for adult and pediatric patients who require the following general types of invasive or non-invasive ventilatory support, as prescribed by an attending doctor:

- Positive Pressure ventilation
- Assist/Control, SIMV, or CPAP modes of ventilation
- Breath types including Volume Control, Pressure Control, and Pressure Support

### Target Environments

The ventilator is suitable for use in institutional, home, and portable settings. It is not intended for use as an emergency transport ventilator.

The Puritan Bennett™ 560 Ventilator is suitable for use on commercial aircraft, per FAA requirements. Refer to chapter [B.11, “Standards Compliance and IEC Classification”](#). Patients traveling with the Puritan Bennett™ 560 Ventilator may be required by their airline to demonstrate evidence of compliance with the RTCA/DO-160F standard, as well as other requirements. Contact your airline prior to travel to determine airline specific requirements and documentation.



### WARNING

**Even though the Puritan Bennett™ 560 Ventilator meets current safety standards, the internal Lithium-ion battery of the device exceeds the 100Wh threshold and is therefore considered to be Dangerous Goods (DG) Class 9 – Miscellaneous, when transported in commerce. As such, the Puritan Bennett™ 560 Ventilator and/or the associated Lithium-ion battery are subject to strict transport conditions under the Dangerous Goods Regulation for air transport (IATA: International Air Transport Association), International Maritime Dangerous Goods code for sea and the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) for Europe. Private individuals who transport the device are excluded from these regulations although for air transport some requirements apply. For air transport; the Puritan Bennett™ 560 Ventilator is permitted as checked-in or carry-on baggage. Two spare batteries per person may be taken on board as carry-on luggage only, with the prior approval of the airline. This classification and regulatory requirements may vary depending upon the country and mode of transport. Therefore it is recommended that users verify with the carrier / airline as to which measures to take before the voyage.**

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### Target Operators

The ventilator may be operated by:

- Respiratory therapists
- Doctors
- Nurses
- Homecare providers

- Patient and patient's families

For more details on the knowledge and skill requirements for operating the Puritan Bennett™ 560 Ventilator, refer to Appendix A Patient/Caregiver Checklist.



#### **WARNING**

**This ventilator must be used only under the responsibility and on the prescription of a doctor.**

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## **2.2 Contraindications**

This ventilator is not for use with anesthetic gases, and is not intended for use as an emergency transport ventilator.

## **2.3 Operational Use**

The Puritan Bennett™ 560 Portable Ventilator uses a micro-turbine to provide ventilatory support to patients. Clinicians may use a variety of interfaces to connect patients to the ventilator: nasal masks or full face masks; endotracheal or tracheotomy tubes. User-selectable ventilation modes are:

- Assisted Controlled Volume (V A/C)
- Assisted Controlled Pressure (P A/C)
- Volume Synchronised Intermittent Mandatory Ventilation (V SIMV)
- Pressure Synchronised Intermittent Mandatory Ventilation (P SIMV)
- Continuous Positive Airway Pressure (CPAP)
- Pressure Support Ventilation with apnea ventilation (PSV/ST)

### **Safety Net**

Incorporated in the ventilator design is an alarm system that continuously monitors both patient and machine for signs of specific errors or faults that could lead to an unsafe condition. Should any of these errors or faults be detected, the alarm system announces the specific alarm condition both audibly and visually. The machine-related alarm conditions are factory set, whereas the patient-related alarm conditions are defined by alarm-threshold values selected by an operator (a clinician or a caregiver). For more information, refer to chapter 5, [“Alarms and Troubleshooting.”](#)

### **Settings**

A software key, known as the “Locking Key,” restricts access to ventilation parameter settings and ventilation mode changes in order to distinguish between “clinician” usage and “patient” usage (refer to section 7.8, [“Locking the Control Panel,”](#) on page 7-25).

### **Oxygen Enrichment**

Oxygen may be supplied from an external, low pressure source, but the oxygen flow must be limited to 15 lpm (50 kPa, 500 mbar). The ventilator automatically compensates for the extra flow created by the external oxygen supply (refer to chapter 6, [“Installation and Assembly.”](#))

### **Breathing Circuit**

The ventilator can be used with a single or double limb patient circuit. If exhaled volume monitoring is required (such as ventilator dependant patients), use the double-limb circuit for exhaled tidal volume monitoring. For more information, refer to section 6.4, [“Patient Circuit,”](#) on page 6-6.



#### **WARNING**

**Users must always possess an additional breathing circuit and exhalation valve while using the Puritan Bennett™ 560 Ventilator.**

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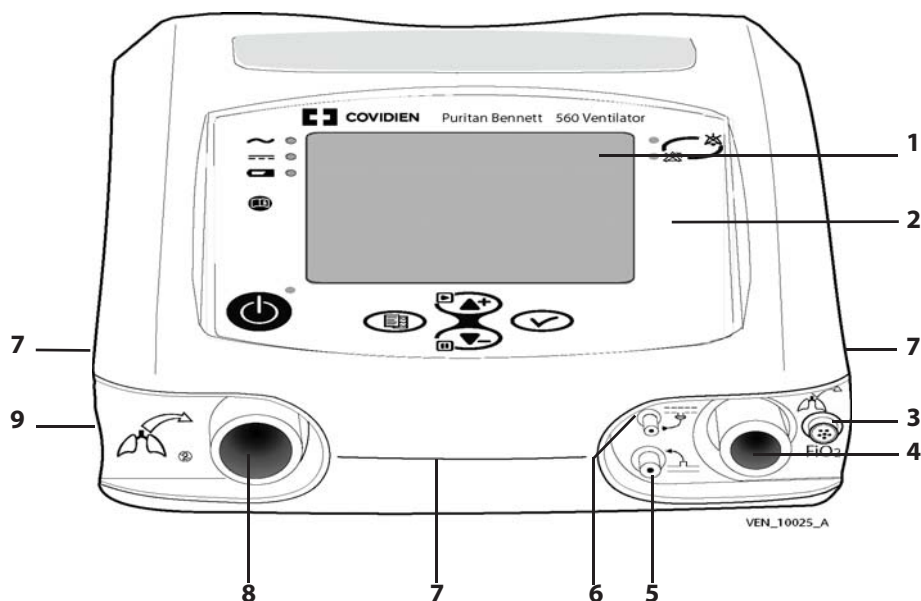
## 2.4 Device Classification

The ventilator's IEC / EN 60601-1 classification is as follows:

- Protection/Insulation class (electric shock): Class II
- Protection index of enclosure: IP31
- Medical device directive classification: II B
- Degree of protection against risk of electric shock: BF
- Power: External (AC – mains, or DC – cigarette lighter) or internal (DC – battery)
- Operation mode: Continuous operation

For additional information, refer to section B, ["Specifications."](#)

## 2.5 Front Panel

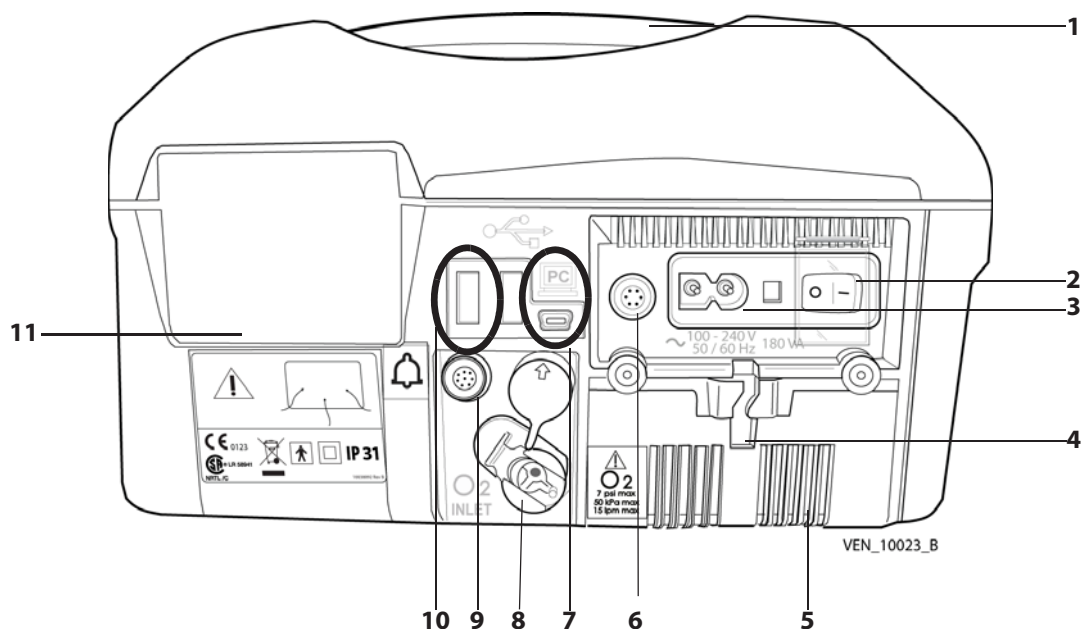


<p><b>1 LCD Display</b> – Displays information about the ventilator including patient hours and software version, ventilation modes and settings, and monitored and calculated patient data and waveforms. The display also allows the user to view and, using the Control Panel, adjust the ventilator's operating and alarm configuration settings.</p>	<p><b>6 Exhalation Valve Port</b> – Nipple for providing piloting pressure to the exhalation valve. Controls the open-closed position of the exhalation valve.</p>
<p><b>2 Control Panel</b> – Features the controls for setting up and operating the ventilator, and LEDs to indicate the ventilator's power source, ventilation On/Off status, and alarm priority level. Control functions include turning on and off the ventilation, configuring ventilation modes, silencing and cancelling alarms, and setting device and alarm parameters.</p>	<p><b>7 Lateral and Front Openings</b> – Vents that allow for air circulation to cool the ventilator's internal components. In addition, these openings function as sound ports for audible alarms.</p> <p><b>⚠ WARNING</b> <b>Do not cover or obstruct these openings.</b></p>
<p><b>3 FiO<sub>2</sub> Sensor Connection</b> - Connection for FiO<sub>2</sub> sensor which monitors the amount of oxygen in the patient circuit.</p>	<p><b>8 From Patient Port</b> - Exhaled volume measurements are taken from this port, through which a portion of the exhaled gas is diverted to the exhalation flow sensor. VTE is calculated from this flow measurement.<sup>a</sup></p>
<p><b>4 Patient Connection Port</b> – Provides an outlet for the gas to be delivered to the patient via the patient circuit.</p>	<p><b>9 Exhaled Gas Outlet</b>– Exhalation Valve connects here.</p>
<p><b>5 Patient Pressure Monitoring Port</b> – Nipple for monitoring proximal patient pressure.</p>	

a. If exhaled tidal volume monitoring is required, use the double-limb circuit.

**Figure 2-1.** Front Panel

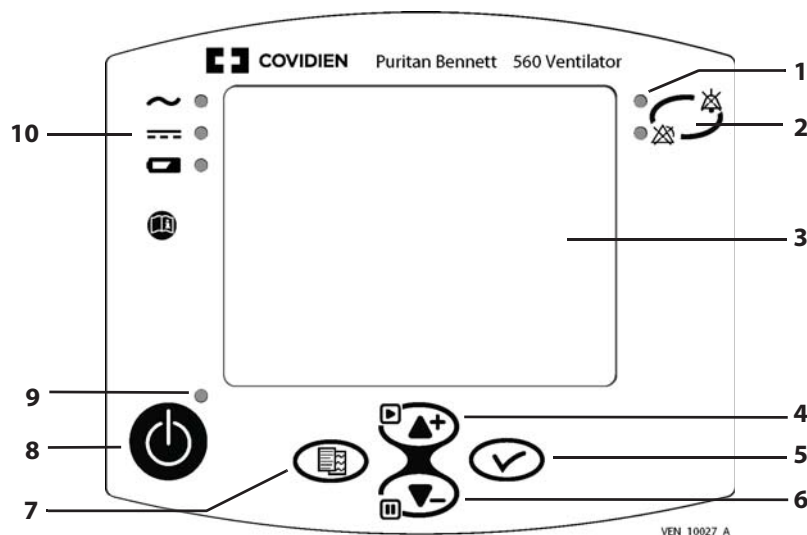
## 2.6 Back Panel



<b>1</b>	Ergonomic carrying handle.	<b>7</b>	PC Cable Connector: USB mini-B connector used for Puritan Bennett™ Ventilator Test Software.
<b>2</b>	On/Off (I/O) switch with protective cover: Device powered on in position I; device switched off in position O.	<b>8</b>	O <sub>2</sub> Inlet Port: Connects the ventilator to a low pressure oxygen source via an adaptor connected to the O <sub>2</sub> Inlet (refer to section 6.8, “Oxygen,” on page 6-13).
<b>3</b>	AC power (“Mains”) cable connector.	<b>9</b>	Nurse Call Output Connector: Used to connect the ventilator to the nurse call system.
<b>4</b>	AC power (“Mains”) cable holding system: Secures AC power cable to avoid accidental disconnection.	<b>10</b>	USB Memory Device connection: USB connection to be used with Puritan Bennett™ respiratory insight software. There are two USB type A ports.
<b>5</b>	Access cover for the internal battery.	<b>11</b>	Air Inlet Filter: Filters air as it enters the ventilator.
<b>6</b>	DC power cable connector with key.		

**Figure 2-2.** Back Panel

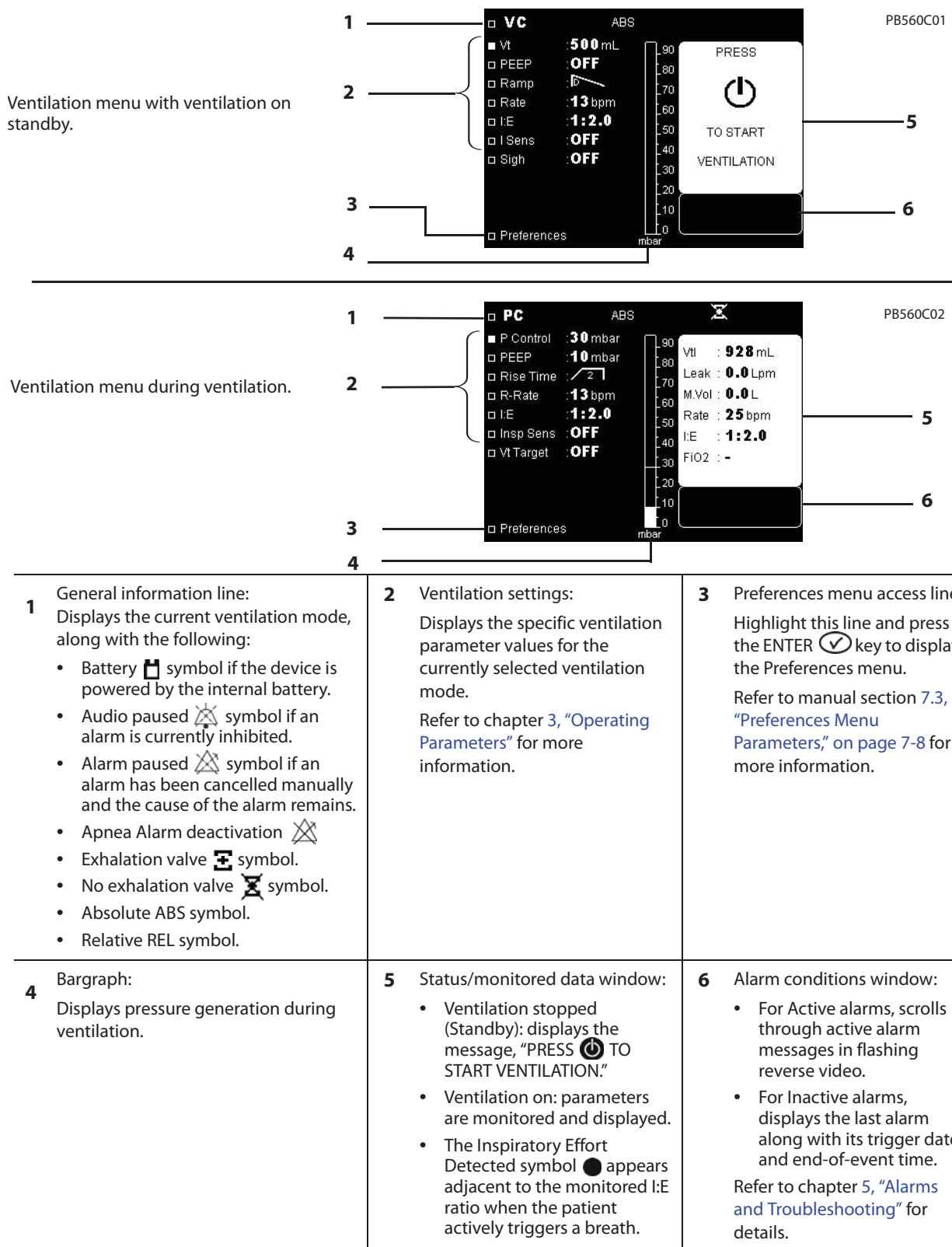
## 2.7 Control Panel



<p><b>1</b> Alarm indicators (two LEDs):</p> <p>Red indicator:</p> <ul style="list-style-type: none"> <li>Continuous: Very High Priority (VHP) alarm activated</li> <li>High priority (HP) alarm activated.</li> </ul> <p>Yellow indicator:</p> <ul style="list-style-type: none"> <li>Medium priority (MP) alarm activated.</li> </ul>	<p><b>6</b> DOWN/FREEZE key:</p> <ul style="list-style-type: none"> <li>Moves the cursor down and decreases parameter values.</li> <li>During ventilation, freezes displayed waveform in the Waveform menu.</li> </ul>
<p><b>2</b> ALARM CONTROL key:</p> <ul style="list-style-type: none"> <li>Press once to silence an audible alarm for 60 seconds.</li> <li>Press twice to halt visual and audible alarms. If alarm is remedied, the alarm is cancelled (other than the high pressure alarm).</li> </ul>	<p><b>7</b> MENU key:</p> <p>Changes the displayed menu. From the Ventilation menu screen, press this key to display the Alarm menu screen.</p> <p>When a USB memory device is inserted into the ventilator, press this key to display the USB memory device screen.</p>
<p><b>3</b> Display screen:</p> <p>Display of modes, ventilation settings, patient data and waveforms, configuration of the ventilator and alarm management.</p>	<p><b>8</b> VENTILATION ON/OFF button:</p> <ul style="list-style-type: none"> <li>Press briefly and release to start ventilation.</li> <li>Press for three (3) seconds to stop ventilation.</li> </ul>
<p><b>4</b> UP/UNFREEZE Key:</p> <ul style="list-style-type: none"> <li>Moves the cursor up and increases parameter values.</li> <li>During ventilation reactivates waveform tracing in the Waveform menu.</li> </ul>	<p><b>9</b> Ventilation status indicator:</p> <ul style="list-style-type: none"> <li>Blue indicator illuminated: device is powered on and ventilation is off (on standby).</li> <li>Blue indicator off: ventilation is on.</li> </ul>
<p><b>5</b> ENTER key:</p> <ul style="list-style-type: none"> <li>Access to a setting value and validation of the modification of this setting.</li> <li>Access to a sub-menu.</li> </ul>	<p><b>10</b> Electrical power source indicators:</p> <ul style="list-style-type: none"> <li>AC POWER indicator lit: AC power source connected.</li> <li>DC POWER indicator lit: DC power source connected.</li> <li>INTERNAL BATTERY indicator lit continuously: Internal battery in use (no external power source connected.)</li> <li>INTERNAL BATTERY indicator flashing: battery charging.</li> </ul>

**Figure 2-3.** Control Panel

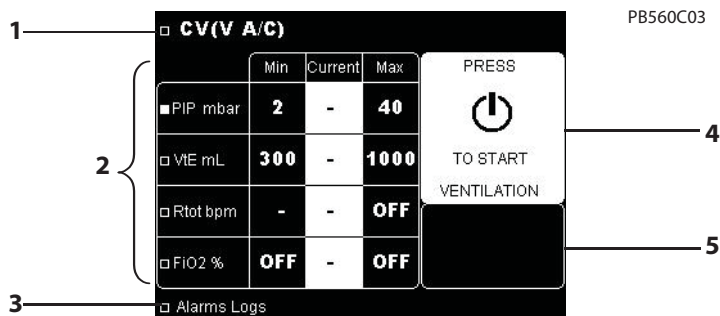
## 2.8 Ventilation Menu



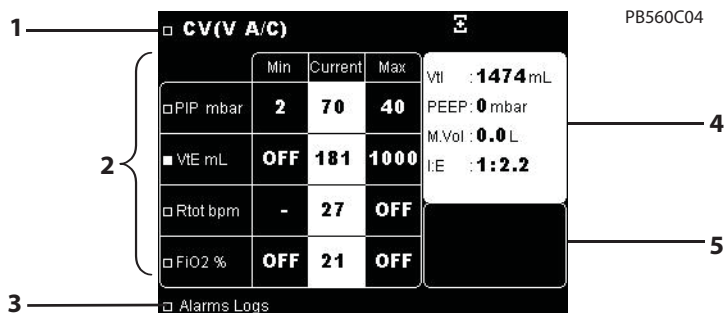
**Figure 2-4.** Ventilation Menu Display

## 2.9 Alarm Menu

Alarm menu with ventilation on standby.



Alarm menu when not in standby.













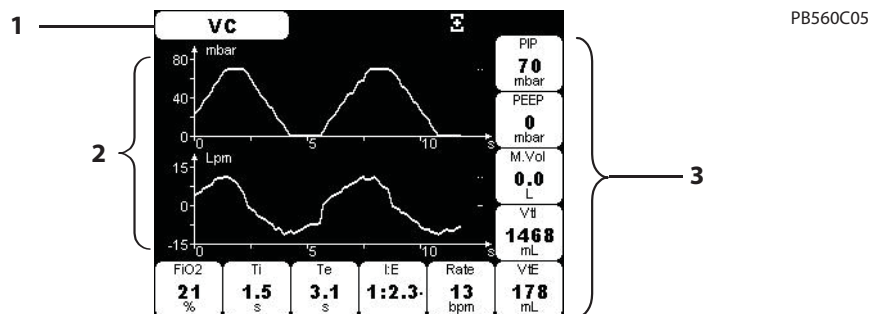
<p><b>1</b> Title line:</p> <p>Displays ventilation mode and the following symbols:</p> <ul style="list-style-type: none"> <li>Battery  if the ventilator is powered by the internal battery.</li> <li>Audio paused  if an alarm is currently inhibited.</li> <li>Alarm paused  if an alarm has been cancelled manually and the cause of the alarm remains.</li> <li>Apnea Alarm deactivation </li> <li>Exhalation valve  symbol.</li> <li>No exhalation valve  symbol.</li> </ul>	<p><b>2</b> Alarm settings:</p> <p>Displays the specific alarm parameter values for the currently selected ventilation mode, which are:</p> <ul style="list-style-type: none"> <li>Min and Max alarm threshold settings, and</li> <li>Current monitored patient readings, or hyphen (-) when ventilation is in standby.</li> </ul>	<p><b>3</b> Access line to Alarm Logs menu.</p> <p>Highlight this line and press the ENTER  key to display the Alarm Logs menu.</p> <p>Refer to manual section 5.3, "Alarm Logs Menu," on page 5-3.</p>
<p><b>4</b> Status/monitored data window:</p> <ul style="list-style-type: none"> <li>Ventilation stopped (Standby): displays the message, "PRESS  TO START VENTILATION."</li> <li>Ventilation on: parameters are monitored and displayed.</li> <li>The Inspiratory Effort Detected symbol  appears adjacent to the monitored I:E ratio when the patient actively triggers a breath.</li> </ul>	<p><b>5</b> Alarm message window:</p> <ul style="list-style-type: none"> <li>For Active alarms, scrolls through active alarm messages in flashing reverse video.</li> <li>For Inactive alarms, displays the last alarm along with its trigger date and end-of-event time.</li> </ul> <p>Refer to chapter 5, "Alarms and Troubleshooting" for more information.</p>	

Figure 2-5. Alarm Menu

## 2.10 Waveforms Menu

The display of waveforms (Figure 2-6) is optional and can be selected using the Menu  key (refer to chapter 4, “Monitored Parameters.”). The Waveform menu is only accessible when ventilation is active.










1	2	3
<p>Title line:</p> <ul style="list-style-type: none"> <li>Displays ventilation mode and the following symbols:</li> <li>Battery  if the ventilator is powered by the internal battery.</li> <li>Audio paused  if an alarm is currently inhibited.</li> <li>Alarm paused  if an alarm has been cancelled manually and the cause of the alarm remains.</li> <li>Apnea Alarm deactivation. </li> <li>Freeze Waveforms  if the tracing of patient waveforms has been halted during ventilation.</li> <li>Exhalation valve  symbol.</li> <li>No exhalation valve  symbol.</li> </ul>	<p>Graphic zone:</p> <p>Displays the patient's pressure and flow waveforms as a function of time.</p> <p>For more information, refer to chapter 4, “Monitored Parameters.”</p>	<p>Numeric zone:</p> <p>Displays monitored data.</p>

Figure 2-6. Waveforms Menu

## 2.11 USB Memory Device Menu

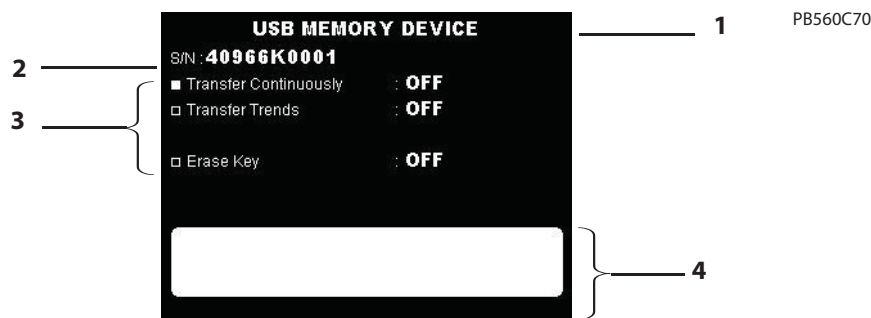


Figure 2-7. USB Memory Device Menu

1	Title line	3	USB Memory Device Menu
2	Ventilator serial number	4	Dialogue box

## 2.12 If Ventilator Failure Occurs

If a problem with the ventilator is suspected, FIRST CHECK THAT THE PATIENT IS NOT IN DANGER. If necessary, remove the patient from the ventilator and provide an alternate means of ventilation.

Keep in mind that troubleshooting information is available in this manual to assist you in the event of a problem. Refer to chapter 5, “Alarms and Troubleshooting”.

If you cannot determine the cause of a problem, contact your equipment supplier or Covidien. Refer to chapter 10.5, “Service Assistance”

# 3 Operating Parameters

This chapter describes ventilation and alarm parameters and their setting ranges for each ventilation mode. For a listing of operating parameters and monitored patient data, refer to [Table B-11](#) on page B-8. For further information about the different ventilation modes and breath types provided by the Puritan Bennett™ 560 Ventilator, refer to [Appendix D, “Modes and Breath Types.”](#)

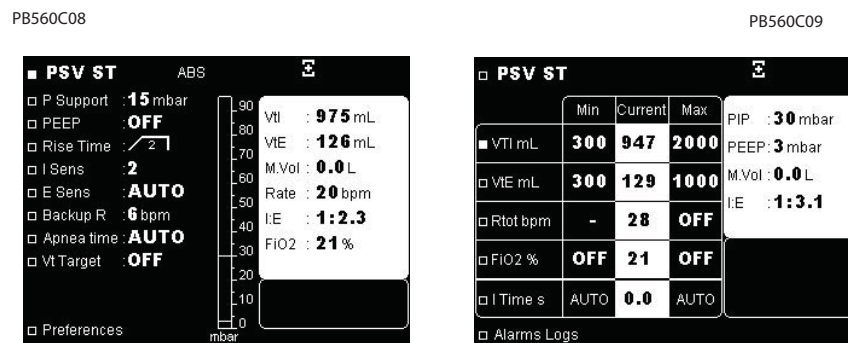


## WARNING

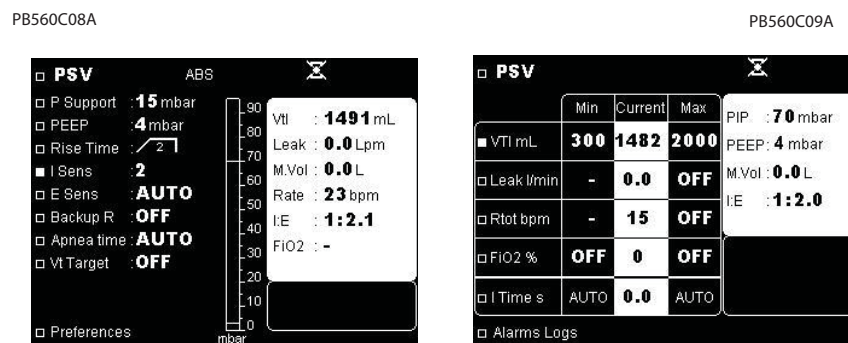
If APNEA TIME is set to a value higher than 60/Rate then the APNEA alarm will not activate.

## 3.1 PSV Mode Parameters and Setting Ranges

The menus for PSV - Pressure Support Ventilation mode are shown in [Figure 3-1](#), and [Figure 3-2](#):



**Figure 3-1.** Menus in PSV Mode with exhalation valve configuration



**Figure 3-2.** Menus in PSV Mode with leakage configuration

The ventilation parameters and setting ranges available in PSV mode are listed in [Table 3-1](#).

**Table 3-1.** Ventilation Parameters in PSV Menu

Name	Units	Min. Value	Max. Value	Adjustment Resolution	Default Value	Linked Parameters
P Support	cmH <sub>2</sub> O, mbar or hPa	Standby: 2 Valve configuration: 5 Leak configuration: 6	Standby: 55 Valve configuration: 55 Leak configuration: 30	1	15	PEEP
PEEP	cmH <sub>2</sub> O, m bar or hPa	Standby: OFF Valve configuration: OFF Leak configuration: 4	20	1	OFF	P Support Max P
Rise Time	–	1	4	1	2	Insp Time
I Sens	–	1P	5	1	2	–
E Sens <sup>a</sup>	%	5 (-95)	95 (-5)	5	Auto	–
Backup R	bpm	4	40	1	13	Min I Time
Apnea Time	s	1	60	1	Auto	Backup R
Vt Target	ml	50	2000	10	OFF = 100	–
Min I Time	s	0.1	2.8	0.1	Auto	Max I Time
Max P	mbar	8	55	1	PIP + 3	–
Max I Time	s	0.8	3	0.1	Auto	Min I Time

a. Refer to chapter 7, “Operating Procedures” for information on positive and *negative* E Sens settings

Table 3-2 lists the available alarm settings in PSV mode.

**Table 3-2.** Alarm Parameters in PSV Mode

Name	Units	Min. Value	Max. Value	Adjustment Resolution	Default Value	Linked Parameters
Min VTi	ml	30	2000	10	300	Max VTi
Max VTi	ml	80	3000	10	2,000	Min VTi
Min VTE (with exhalation valve)	ml	30	1990	10	300	Max VTE
Max VTE (with exhalation valve)	ml	80	3000	10	1000	Min VTE
Max Leak (with leak configuration)	lpm	5	200	5	OFF	–
Max Rtot	bpm	10	70	1	OFF	Backup R
Min FiO <sub>2</sub>	%	18	90	1	OFF	Max FiO <sub>2</sub>
Max FiO <sub>2</sub>	%	30	100	1	OFF	Min FiO <sub>2</sub>

### P Support - Pressure Support

When Relative Pressure is set to YES in the Setup Menu, P Support allows you to determine inspiratory pressure added to PEEP during the inspiratory phase.

In this configuration, the sum of P Support and PEEP must not exceed 55 mbar.

When Relative Pressure is set to OFF in the Setup Menu, P Support allows you to determine inspiratory Absolute pressure.

In this configuration, P Support and PEEP are related and their settings must maintain a minimum difference between the two of 2 mbar in leak configuration and 5 mbar in valve configuration.

### PEEP – Positive End Expiratory Pressure

PEEP allows you to determine the level of pressure maintained during the exhalation phase.

When Relative Pressure is set to YES in the Setup Menu, the sum of P Support and PEEP must not exceed 55 mbar.

When relative pressure is set to OFF, P Support and PEEP are related and their settings must maintain a minimum difference between the two of 2 mbar in leak configuration and 5 mbar in valve configuration.


The ventilation mode can be adjusted without PEEP (PEEP is nearly 0 mbar when set to “OFF”) in valve configuration.


In leak configuration, the minimum PEEP setting is 4 mbar.


### Rise Time

This parameter is used during the inspiration phase to determine how the target pressure will be reached. This setting indirectly defines the minimum inspiratory time.

The different levels available are as follows:

Rise time  = 200 ms

Rise time  = 400 ms

Rise time  = 600 ms

Rise time  = 800 ms

These time ranges are determined by the pressure setting required, the breath rate, and the physiological condition of the patient.

### I Sens – Inspiratory Trigger Sensitivity

I Sens allows you to set the level of inspiratory effort the patient has to provide during the initiation of a machine breath.

The sensitivity levels decrease from 1P to 5: the lower the number, the more sensitive the trigger sensitivity. These levels correspond to differences in flow compared to the bias flow.

I Sens 1 (P) = Bias flow + (0.4 lpm to 1 lpm) (P = Pediatric use)

I Sens 2 = Bias flow + (0.7 lpm to 1.3 lpm)

I Sens 3 = Bias flow + (0.9 lpm to 1.5 lpm)

I Sens 4 = Bias flow + (1.0 lpm to 1.6 lpm)

I Sens 5 = Bias flow + (1.2 lpm to 1.8 lpm)

The bias flow consists of turbine flow through the patient circuit, during the exhalation phase, that helps the patient avoid rebreathing exhaled gas (CO<sub>2</sub>).

The inspiratory trigger is initiated after a time delay of between 700 ms to 1500 ms, depending on the preceding peak inspiratory flow.



#### WARNING

**Ensure that the I Sens setting is not set to OFF when ventilating patients capable of triggering spontaneous breaths.**

**Carefully modify the trigger threshold setting to reduce the risk of ventilator autotriggering. Level 1P, the most sensitive inspiratory trigger, is recommended for pediatric use. For an adult, this setting may result in ventilator autotriggering.**

### E Sens – EXHALATION SENSITIVITY

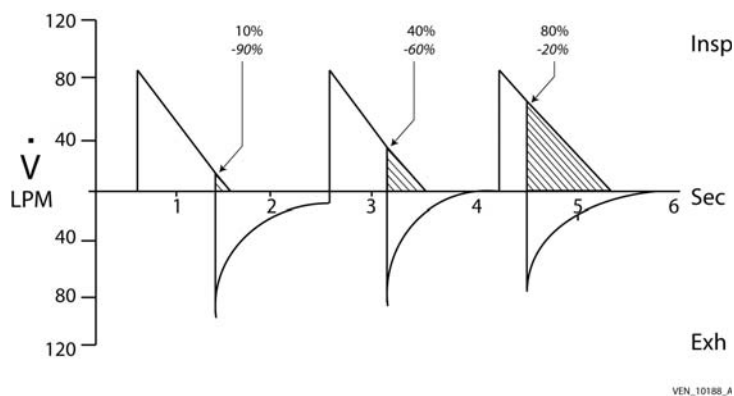
E Sens is available in the PSIMV, VSIMV, and PSV modes.

E Sens allows you to determine sensitivity of switching to exhalation and thus indirectly determines the inspiratory time of a breath.

The end of inspiration will occur when Inspiratory Flow has decreased to the preset E Sens setting.

The exhalation trigger is only taken into account after the Rise Time (which constitutes a default minimum inspiratory time) has elapsed.

If the flow drop is insufficient, exhalation is automatically triggered independently of the E Sens, which is defined as a percentage of peak inspiratory flow. Exhalation may be triggered if the maximum inspiratory time of three (3) seconds has elapsed, which corresponds to an I:E Ratio of 1:1.0, to ensure that the patient has enough time to exhale.



**Figure 3-3.** Exhalation Trigger Sensitivity

**Note:**

(Refer to chapter 7.2.2 , “Changing the Setup Menu Parameters” for positive and *negative* E Sens settings.)

### Backup R

Backup R allows you to determine the frequency of ventilation breaths to be applied in the event of prolonged apnea—as long as no inspiratory trigger is detected.

The inspiratory time of the backup breaths applied in the event of apnea still depends on the detection of Exhalation trigger (E Sens) and the safety maximum inspiratory time (see above comment on E Sens). The rise time of these cycles is identical to the ventilation cycle previously set.

The controlled cycles following apnea are interrupted as soon as a new spontaneous inspiration of the patient is detected.

The Backup R is linked to the Min I Time so that the Min I Time setting cannot be greater than half the inspiratory phase of a ventilator controlled breath.

Backup R breath is delivered at the Pressure Support settings.

Setting a Backup Rate is not optional; it is always set.

### Apnea Time

Apnea time allows the user to monitor and detect interruptions to the patient's spontaneous breathing pattern. The ventilator declares apnea when no breath has been delivered by the time that the operator-selected apnea interval elapses.

The APNEA TIME adjustment range shall be 1 to 60 seconds. The ventilator shall enable the operator to set an auto-setting which shall automatically calculate the APNEA TIME according to the following:  $APNEA\ TIME = 60 / BACKUP\ R$  for PSV ST mode or 12 s for V SIMV and P SIMV modes.

The Apnea Time "AUTO" setting (in seconds) is calculated using the formula (Auto = Maximum value between 3 seconds and  $60/Backup\ R$  or  $AUTO=30$  in CPAP mode).

**Note:**

During apnea ventilation, the ventilator delivers machine controlled breaths according to a backup rate (Backup R)—as long as no inspiratory trigger has been detected.

The Backup R value applied depends on the Rate setting.

If the Apnea Alarm is set to OFF in the Preferences Menu, the Apnea Time setting will still be active.

### **VT Target - TARGET TIDAL VOLUME**

VT Target allows the ventilator to deliver a target volume of gas to the patient.

When a VT Target is set, the ventilator constantly adjusts the target inspiratory pressure between PIP and Max P to ensure the inspired tidal volume remains as close as possible to the VT target.

VT Target should be more than 10 ml higher than Min VTE and more than 10 ml lower than Max VTI to avoid triggering VTI or VTE alarms.

The minimum increase or decrease of target inspiratory pressure is 0.5 mbar and the maximum is 2 mbar.

Setting the Vt Target is not mandatory (it can be set to "OFF").

### **Max P - MAXIMUM INSPIRATION PRESSURE**

Max P allows the ventilator to adjust the inspiratory pressure up to a maximum limit in order to reach the Target Tidal Volume. (Vt Target)

P Support and Max P are related and the difference between them must be less than 20 mbar.

Max P is not displayed when VT Target is set to OFF.

### **Min and Max I Time – MINIMUM / MAXIMUM INSPIRATION TIME**

Min I Time and Max I Time are ventilation parameters that can be adjusted in the alarm menu.

Min I Time defines the minimum duration of time the inspiratory phase is maintained. It takes priority over activation of the exhalation trigger which can only be triggered after the Min I Time has expired.

The Backup R is linked to the Min I Time so that the Min I Time setting cannot be greater than half the inspiratory phase of a cycle triggered by the ventilator.

If Backup R is changed, Min I Time is, if necessary, automatically readjusted so that the difference between them is always maintained.

The minimum time by default if no parameter is set (Min I Time = AUTO) corresponds to the lower value in the range of the Rise Time to which an operating margin of 0.3 seconds is added. See "[Rise Time](#)" on page 3-3 for details about Rise Time.

Max I Time defines the maximum duration of time during which the inspiratory phase is maintained. The switch-over to exhalation occurs, at the latest, after this time has expired.

By default, if no parameter is set, the maximum time (Max I Time = AUTO) is the shortest time between a fixed time of three (3) seconds and half the duration of the patient's inspiratory breaths expressed in seconds. (AUTO equals  $Rise\ Time + 0.3\ seconds$ ). This default value will be applied if it is lower than the Max I Time setting.

Min I Time and Max I Time are related so that the Max I Time cannot be set to a value lower than the Min I Time.

### **VTI (Min and/or Max Alarm Settings) – INSPIRATORY TIDAL VOLUME**

It is possible to set a minimum and/or maximum Tidal Volume alarm threshold for the patient's inspired tidal volume during a cycle.

This setting is used to trigger an alarm if the Tidal volume inspired by the patient is lower than the minimum threshold set ("LOW VTI" alarm) or greater than the maximum threshold set ("HIGH VTI" alarm). Refer to chapter 5, ["Alarms and Troubleshooting"](#).

Min VTI and Max VTI are related, and their settings must be set to values that maintain a minimum difference of 20 ml between the two.

It is not mandatory to set the minimum and maximum VTI alarm limits. When the minimum and maximum VTI alarm limits are not set, the display will read "OFF" for these settings.

### **VTE (Min and/or Max Alarm Settings) – EXHALATION TIDAL VOLUME**

Use a double limb patient circuit configuration when setting the minimum and/or maximum Exhalation Tidal Volume alarm parameters.

These thresholds can be set to trigger an alarm if the Tidal volume expired by the patient is lower than the minimum threshold set ("LOW VTE" alarm) or greater than the maximum threshold set ("HIGH VTE" alarm). Refer to chapter 5, ["Alarms and Troubleshooting"](#).

Min VTE and Max VTE are related and their settings must be set to values that maintain a minimum difference of 20 ml between the two.

VTE is displayed when ventilating with an exhalation valve.

It is not mandatory to set the minimum and maximum VTE alarm limits. When the minimum and maximum VTE alarm limits are not set, the display will read "OFF" for these settings.

### **Max Leak (Max Alarm Settings)**

The setting of a high leakage threshold enables a "HIGH LEAKAGE" alarm to be triggered in the event the calculated leakage flow exceeds this limit. The displayed value corresponds to the mean parasitic leakage flow observed during the exhalation phase.

Max Leak is displayed when ventilating without an exhalation valve.

Setting the Max Leak is not mandatory (it can be set to "OFF"), but the measured value is always displayed.

### **Max Rtot (Max Alarm Setting) – TOTAL BREATH RATE**

The maximum rate threshold set is used to warn of hyperventilation or ventilator autotriggering.

The alarm setting is used to trigger the "HIGH RATE" alarm. Refer to chapter 5, ["Alarms and Troubleshooting"](#).

When set, the Max Rtot threshold must always exceed the Backup Rate by 5 bpm. If the Backup Rate is readjusted, the Max Rtot is automatically readjusted to maintain a minimum difference of 5 bpm.

Setting the Max Rtot is not mandatory (it can be set to "OFF"), but the measured value is always displayed.

### **FiO<sub>2</sub> - (Min and/or Max Alarm Settings) - FRACTION OF INSPIRED OXYGEN**

An FiO<sub>2</sub> sensor connected to the patient circuit allows you to determine that the correct level of oxygen is being delivered to the patient.

Min and Max FiO<sub>2</sub> thresholds can be set to trigger "LOW FIO<sub>2</sub>" or "HIGH FIO<sub>2</sub>" alarms.

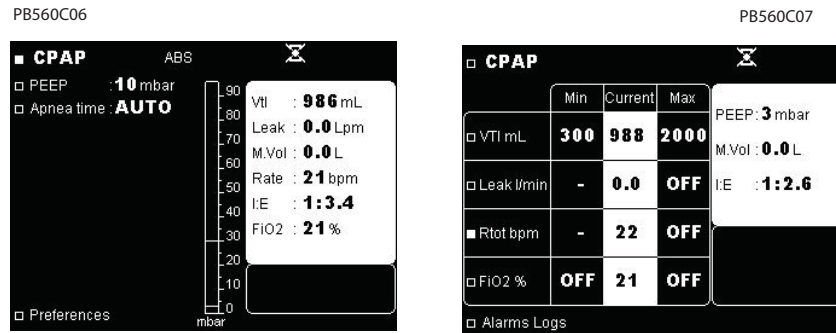
Min FiO<sub>2</sub> and Max FiO<sub>2</sub> thresholds are related and their settings must maintain a minimum difference of 10% between the two.

Min and Max FiO<sub>2</sub> settings can be set to OFF if an FiO<sub>2</sub> sensor is not connected. Settings are automatically restored once a sensor is reconnected.

These settings are the same for all ventilation modes.

## 3.2 CPAP Mode Parameters and Setting Ranges

The menus in CPAP (Continuous Positive Airway Pressure) ventilation mode are shown below:



**Figure 3-4.** Menus in CPAP Mode in leakage configuration

The ventilation parameters and setting ranges available in CPAP mode are listed in [Table 3-3](#).

**Table 3-3.** Ventilation Parameters in CPAP Menu

Name	Units	Min. Value	Max. Value	Adjustment Resolution	Default Value	Linked Parameters
PEEP	cmH <sub>2</sub> O, mbar or hPa	4	20	1	10	PIP
Apnea Time <sup>a</sup>	s	1	60	1	Auto	Backup R

a. not available if Apnea Alarm is set to OFF in Preferences Menu

[Table 3-4](#) lists the available alarm settings in CPAP mode.

**Table 3-4.** Alarm Parameters in CPAP Mode

Name	Units	Min. Value	Max. Value	Adjustment Resolution	Default Value	Linked Parameters
Min VTI	ml	30	2,000	10	300	Max VTI
Max VTI	ml	80	3,000	10	2,000	Min VTI
Max Leak	lpm	5	200	5	OFF	-
Max Rtot	bpm	10	70	1	OFF	Backup R
Min FiO <sub>2</sub>	%	18	90	1	OFF	Max FiO <sub>2</sub>
Max FiO <sub>2</sub>	%	30	100	1	OFF	Min FiO <sub>2</sub>



### WARNING

The CPAP mode does not feature control cycles. Do not use this mode for ventilator-dependent patients.

### Note:

Only leak configuration is available in CPAP mode.

### **PEEP – Positive End Expiratory Pressure**

PEEP allows you to determine the level of pressure maintained during the exhalation phase.

The ventilation mode can be adjusted without PEEP (PEEP is nearly 0 mbar when set to “OFF”).

A PEEP value can be set to determine the level of pressure maintained during the inspiratory phase and the exhalation phase.

### **Apnea Time**

Apnea time allows the user to monitor and detect interruptions to the patient's spontaneous breathing pattern. The ventilator declares apnea when no breath has been delivered by the time that the operator-selected apnea interval elapses.

The Apnea Time “AUTO” setting is 30 seconds.

Apnea Time is not available if Apnea Alarm is set to OFF in the Preferences Menu.

### **VTI (Min and/or Max Alarm Settings) – INSPIRATORY TIDAL VOLUME**

It is possible to set a Min and/or Max Tidal Volume alarm threshold for the patient's inspired tidal volume during a cycle.

This setting is used to trigger an alarm if the Tidal volume inspired by the patient is lower than the minimum threshold set (“LOW VTI” alarm) or greater than the maximum threshold set (“HIGH VTI” alarm). Refer to chapter 5, [“Alarms and Troubleshooting”](#).

Min VTI and Max VTI are related, and their settings must be set to values that maintain a minimum difference of 20 ml between the two.

It is not mandatory to set the minimum and maximum VTI alarm limits. When the minimum and maximum VTI alarm limits are not set, the display will read “OFF” for these settings.

### **Max Leak (Max Alarm Settings)**

The setting of a high leakage threshold enables a “HIGH LEAKAGE” alarm to be triggered in the event the calculated leakage flow exceeds this limit. The displayed value corresponds to the mean parasitic leakage flow observed during the exhalation phase.

It is not mandatory to set the minimum and maximum LEAK alarm limits. When the minimum and maximum LEAK alarm limits are not set, the display will read “OFF” for these settings.

### **Max Rtot (Max Alarm Setting) – TOTAL BREATH RATE**

The maximum rate threshold set is used to warn of hyperventilation or ventilator autotriggering.

The alarm setting is used to trigger the “HIGH RATE” alarm. Refer to chapter 5, [“Alarms and Troubleshooting”](#).

When set, the Max Rtot threshold must always exceed the Backup Rate by 5 bpm. If the Backup Rate is readjusted, the Max Rtot is automatically readjusted to maintain a minimum difference of 5 bpm.

Setting the Max Rtot is not mandatory (it can be set to “OFF”), but the measured value is always displayed.

### **I Sens - INSPIRATORY TRIGGER SENSITIVITY**

The trigger threshold for switching to inhalation cannot be set in CPAP mode. The device is configured with a default I Sens of 2.

### E Sens - EXHALATION TRIGGER SENSITIVITY

The trigger threshold for switching to exhalation cannot be set in CPAP mode. The device is configured with a default E Sens of 25%.

### FIO<sub>2</sub> (Min and/or Max Alarm Settings) - Fraction of Inspired Oxygen

An FiO<sub>2</sub> sensor connected to the patient circuit allows you to determine that the correct level of oxygen is being delivered to the patient.

Min and Max FiO<sub>2</sub> thresholds can be set to trigger "LOW FIO<sub>2</sub>" or "HIGH FIO<sub>2</sub>" alarms.

Min FiO<sub>2</sub> and Max FiO<sub>2</sub> thresholds are related and their settings must maintain a minimum difference of 10% between the two.

Min and Max FiO<sub>2</sub> settings can be set to OFF if an FiO<sub>2</sub> sensor is not connected. Settings are automatically restored once a sensor is reconnected.

These settings are the same for all ventilation modes.

## 3.3 P A/C Mode Parameters and Setting Ranges

The menus in P A/C (Pressure Assisted/Controlled) ventilation mode are shown in [Figure 3-5](#).

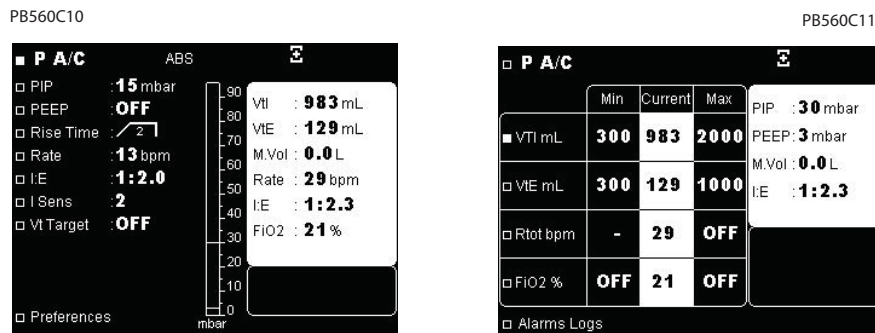


Figure 3-5. Menus in P A/C Mode with exhalation valve configuration

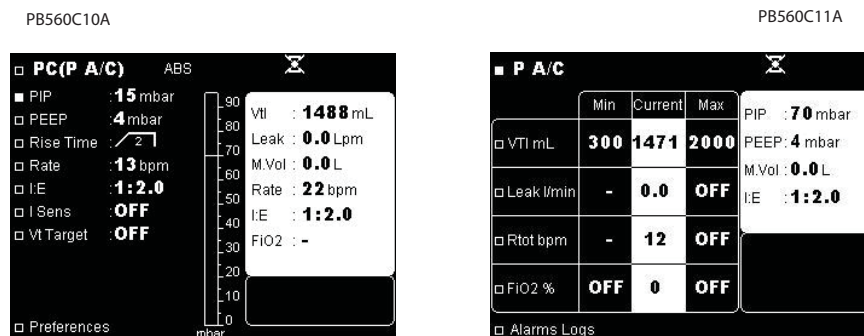


Figure 3-6. Menus in PA/C Mode with leakage configuration

The Ventilation parameters adjustable in P A/C mode are listed in [Table 3-5](#).

**Table 3-5.** Ventilation Parameters in P A/C Mode Menu

Name	Units	Min. Value	Max. Value	Adjustment Resolution	Default Value	Linked Parameters
PIP	cmH <sub>2</sub> O, mbar or hPa	Standby: 2 Valve configuration: 5 Leak configuration: 6	Standby: 55 Valve configuration: 55 Leak configuration: 30	1	15	PEEP
PEEP	cmH <sub>2</sub> O, mbar or hPa	Standby: OFF Valve configuration: OFF Leak configuration: 4	20	1	OFF	PIP
Rise Time	–	1	4	1	2	Rate I/T
Rate	bpm	5	60	1	13	Max Rtot Vt
I:E/ (I/T)	s	1/4 (20%)	1/1 (50%)	1/0.1 (1%)	1/2 (33%)	–
I Sens	–	OFF	5	1	2	–
VT Target	ml	50	2000	10	OFF	Min VTE Max VTE Min VTi Max VTi
Max P	cmH <sub>2</sub> O, mbar or hPa	8	55	1	PIP + 3	PIP PEEP

Table 3-6 lists the adjustable alarm parameters in P A/C mode.

**Table 3-6.** Alarm Parameters in P A/C Mode

Name	Units	Min. Value	Max. Value	Adjustment Resolution	Default Value	Linked Parameters
Min VTi	ml	30	2,000	10	300	Max VTi
Max VTi	ml	80	3,000	10	2000	Min VTi
Min VTE (with exhalation valve)	ml	30	1,990	10	300	Max VTE
Max VTE (with exhalation valve)	ml	80	3,000	10	1000	Min VTE
Max Leak (leakage configuration)	ml	5	200	5	OFF	–
Max Rtot	bpm	10	70	1	OFF	Rate
Min FiO <sub>2</sub>	%	18	90	1	OFF	Max FiO <sub>2</sub>
Max FiO <sub>2</sub>	%	30	100	1	OFF	Min FiO <sub>2</sub>

### PIP – Peak Inspiratory Pressure

When Relative Pressure is set to YES in the Setup Menu, PIP allows you to determine inspiratory pressure added to PEEP during the inspiratory phase.

In this configuration, the sum of PIP and PEEP must not exceed 55 mbar.

When Relative Pressure is set to OFF in the Setup Menu, PIP allows you to determine inspiratory Absolute pressure.

In this configuration, PIP and PEEP are related and their settings must maintain a minimum difference between the two of 2 mbar in leak configuration and 5 mbar in valve configuration.

### PEEP – Positive End Expiratory Pressure

PEEP allows you to determine the level of pressure maintained during the exhalation phase.

When Relative Pressure is set to YES in the Setup Menu, the sum of PIP and PEEP must not exceed 55 mbar.

When relative pressure is set to OFF, PIP and PEEP are related and their settings must maintain a minimum difference between the two of 2 mbar in leak configuration and 5 mbar in valve configuration.


The ventilation mode can be adjusted without PEEP (PEEP is nearly 0 mbar when set to “OFF”) in valve configuration.


In leak configuration, the minimum PEEP setting is 4 mbar.


### Rise Time

This parameter is used during the inspiration phase to adjust how the pressure setpoint will be reached. This setting indirectly defines the minimum inspiratory time.

The different levels available are as follows:

Rise time  = 200 ms

Rise time  = 400 ms

Rise time  = 600 ms

Rise time  = 800 ms

These time ranges are determined by the combination of the pressure setting required, the breath rate and the physiological conditions of the patient.

The pressure rise time built-up at each cycle depends on the inspiratory time corresponding to the combination of the rate setting and the Insp Time setting.

- Rise Time is always possible
- Rise Time is established only if Insp Time  $\geq$  0.7 seconds
- Rise Time is established only if Insp Time  $\geq$  0.9 seconds
- Rise Time is established only if Insp Time  $\geq$  1.1 seconds.

#### Note:

Insp Time is not a setting and is displayed as Ti when the I:E or I/T ratio is adjusted.

### Rate – RESPIRATORY RATE

Rate allows you to define the minimal frequency of mandatory ventilator breaths.

If the patient actuates the inspiration trigger, Total Rate may increase.

#### Note:

Insp Time is not a setting and is displayed as Ti when the I:E or I/T ratio is adjusted.

### I:E (I/T) Cycling rate

I:E allows you to determine the ratio between the inspiratory breath phase duration and the exhalation breath phase duration.

I/T allows you to determine the ratio between the inspiratory breath phase duration and the total breath duration (inhalation + exhalation).

**Note:**

Insp Time is not a setting and is displayed as Ti when the I:E or I/T ratio is adjusted.

### **I Sens – INSPIRATORY TRIGGER SENSITIVITY**

I Sens allows you to set the level of inspiratory effort the patient has to provide to initiate a machine breath.

The sensitivity levels decrease from 1P to 5: the lower the number, the more sensitive the trigger sensitivity. These levels correspond to differences in flow compared to the bias flow.

I Sens 1 (P) = Bias flow + (0.4 lpm to 1 lpm) (P = Pediatric use)

I Sens 2 = Bias flow + (0.7 lpm to 1.3 lpm)

I Sens 3 = Bias flow + (0.9 lpm to 1.5 lpm)

I Sens 4 = Bias flow + (1.0 lpm to 1.6 lpm)

I Sens 5 = Bias flow + (1.2 lpm to 1.8 lpm)

The bias flow consists of turbine flow through the patient circuit, during the exhalation phase, that helps the patient avoid rebreathing exhaled gas (CO<sub>2</sub>).

The inspiratory trigger is initiated after a time delay of between 700 ms to 1500 ms, depending on the preceding peak inspiratory flow. I Sens can be set to OFF.



**WARNING**

**The inspiration trigger threshold should be carefully modified in order to avoid the risk of false triggering or “autotriggering” of the ventilator. For example, Level 1P, the most sensitive mode, is recommended for pediatric use. However, for an adult, this setting may result in autotriggering.**

### **VT Target - TARGET TIDAL VOLUME**

VT Target allows the ventilator to deliver a target volume of air to the patient.

When a VT Target is set, the ventilator constantly adjusts the target inspiratory pressure between PIP and Max P to ensure the inspired tidal volume remains as close as possible to the VT target.

VT Target should be more than 10 ml higher than Min VTE and more than 10 ml lower than Max VTI to avoid triggering VTI or VTE alarms.

The minimum increase or decrease of target inspiratory pressure is 0.5 mbar and the maximum is 2 mbar.

Setting the Vt Target is not mandatory (it can be set to “OFF”).

### **Max P - MAXIMUM INSPIRATION PRESSURE**

Max P allows the ventilator to adjust the inspiratory pressure up to a maximum limit in order to reach the Target Tidal Volume. (Vt Target)

PIP and Max P are related and the difference between them must be less than 20 mbar.

Max P is not displayed when VT Target is set to OFF.

### **VTI (Min and/or Max Alarm Settings) – INSPIRATORY TIDAL VOLUME**

It is possible to set a Min and/or Max Tidal Volume alarm threshold for the patient’s inspired tidal volume during a cycle.

This setting is used to trigger an alarm if the tidal volume inspired by the patient is lower than the minimum threshold set (“LOW VTI” alarm), or greater than the maximum threshold set (“HIGH VTI” alarm). Refer to chapter 5, “Alarms and Troubleshooting”.

Min VTI and Max VTI are related and their settings must be set to values that maintain a minimum difference of 20 ml between the two.

It is not mandatory to set the minimum and maximum VTI alarm limits. When the minimum and maximum VTI alarm limits are not set, the display will read "OFF" for these settings.

### **VTE (Min and/or Max Alarm Settings) – EXPIRED TIDAL VOLUME**

A Min and/or Max Tidal volume expired by the patient can always be set but can only be used in a double limb circuit configuration.

These thresholds can be set to trigger an alarm if the Tidal volume expired by the patient is lower than the minimum threshold set ("LOW VTE" alarm) or greater than the maximum threshold set ("HIGH VTE" alarm). Refer to chapter 5, ["Alarms and Troubleshooting"](#).

Min VTE and Max VTE are related and their settings must be set to values that maintain a minimum difference of 20 ml between the two.

VTE is displayed when ventilating with an exhalation valve.

Setting Min VTE and Max VTE is not mandatory (they can be set to "OFF"), but the display of the measured value is always active in double limb configuration.

### **Max Leak**

The setting of a high leakage threshold enables a "HIGH LEAKAGE" alarm to be triggered in the event the calculated leakage flow exceeds this limit. The displayed value corresponds to the mean parasite leakage flow observed during the exhalation phase.

### **Max Rtot (Max Alarm Setting) – TOTAL BREATH RATE**

The maximum rate threshold setting is used to warn of hyperventilation or autotriggering of the ventilator. This setting is used to trigger the "HIGH RATE" alarm. Refer to chapter 5, ["Alarms and Troubleshooting"](#).

The Max Rtot threshold must always be set at least 5 bpm higher than the Rate. If the Rate is readjusted, the Max Rtot is automatically readjusted to maintain a minimum difference of 5 bpm.

Setting the Max Rtot is not mandatory (it can be set to "OFF"), but the measured value is always displayed.

### **FIO2 (Min and/or Max Alarm Settings) - FRACTION OF INSPIRED OXYGEN**

An FiO<sub>2</sub> sensor connected to the patient circuit allows you to determine that the correct level of oxygen is being delivered to the patient.

Min and Max FiO<sub>2</sub> thresholds can be set to trigger "LOW FIO2" or "HIGH FIO2" alarms.

Min and Max FiO<sub>2</sub> thresholds are related and their settings must maintain a minimum difference of 10% between the two.

Min and Max FiO<sub>2</sub> settings can be set to OFF if an FiO<sub>2</sub> sensor is not connected. Settings are automatically restored once a sensor is reconnected.

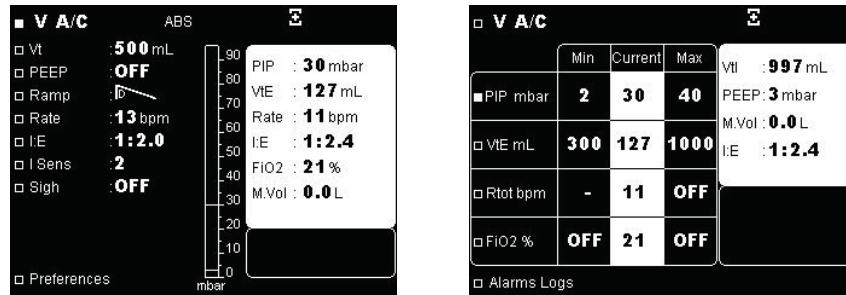
These settings are the same for all ventilation modes.

### 3.4 V A/C Mode Parameters and Setting Ranges

The menus in the V A/C (Volume Assisted/Controlled) ventilation mode are shown in [Figure 3-7](#).

PB560C12

PB560C13



**Figure 3-7.** Menus in the V A/C Mode

The ventilation parameters that are adjustable in the V A/C mode are shown in [Table 3-7](#) on page 3-14.

**Table 3-7.** Ventilation Parameters in V A/C Ventilation Mode

Name	Units	Min. Value	Max. Value	Adjustment Resolution	Default Value	Linked Parameters
Vt	ml	50	2000	10	500	Rate Min VTE Max VTE Vt Sigh
PEEP	cmH <sub>2</sub> O, mbar or hPa	OFF	20	1	OFF	Min PIP Max PIP
Ramp Pattern	–	D	SQ	–	D	–
Rate	bpm	5	60	1	13	Vt Max Rt
I:E (I/T)	– (%)	1/4 (20%)	1/1 (50%)	1/0.1 (1%)	1/2 (33%)	–
I Sens	–	1P	5	1	2	–
Sigh <sup>a</sup> Rate		50	250	50	50	–
Sigh Vt	–	1.0	2.0	0.1	1	–

a. When set to YES, Sigh Vt and Sigh Rate are displayed. A Sigh Rate of 50 means a sigh is delivered every 50 breaths.

The alarm parameters adjustable in V A/C mode are as follows:

**Table 3-8.** V A/C Mode Alarm Parameters

Name	Units	Min. Value	Max. Value	Adjustment Resolution	Default Value	Linked Parameters
Min PIP	cmH <sub>2</sub> O, mbar or hPa	2	52	1	2	PEEP Max PIP
Max PIP	cmH <sub>2</sub> O, mbar or hPa	12	60	1	40	PEEP Min PIP

**Table 3-8.** V A/C Mode Alarm Parameters (Continued)

Name	Units	Min. Value	Max. Value	Adjustment Resolution	Default Value	Linked Parameters
Min VTE	ml	30	1,990	10	300	Vt
Max VTE	ml	80	3,000	10	1000	Vt
Max Rtot	bpm	10	70	1	OFF	Rate
Min FiO2	%	18	90	1	OFF	Max FiO2
Max FiO2	%	30	100	1	OFF	Min FiO2

**Vt – VOLUME CONTROL**

Vt allows you to set the tidal volume to be delivered to the patient at each inspiratory phase.

For physiological and safety reasons, the Vt setting is limited by the settings of Insp Time and Rate.

The ratio of Vt to Insp Time ( $Vt / \text{Insp Time}$ ) is  $[3 < (Vt \times 60) / (\text{Insp Time} \times 1000) < 100]$ .

**WARNING**

**Ensure that the patient circuit is appropriate for the tidal volume setting (tube Ø 22 mm for adults, and Ø 15 mm for pediatric tidal volumes lower than 200 ml).**

**PEEP – POSITIVE END EXPIRATORY PRESSURE**




PEEP allows you to determine the level of pressure maintained during the exhalation phase.

The ventilation mode can be adjusted without PEEP (PEEP is nearly 0 mbar when set to “OFF”).

**Ramp Pattern – FLOW SHAPE**

This parameter is used to adjust the flow distribution shape (or ramp pattern) during the inspiratory phase.

The three flow patterns available are:

- Ramp Pattern:  (square waveform) or constant flow
- Ramp Pattern:  Decelerated (sawtooth waveform) or decreasing flow.
- Ramp Pattern:  Sinusoidal flow

**Rate – RESPIRATORY RATE**

Rate allows you to define the frequency of ventilation cycles triggered by the ventilator.

If the patient actuates the inspiratory trigger, Total Rate may increase.

For physiological and efficiency reasons, Rate setting is limited by the settings of Vt and I:E (I/T).

**I:E (I/T) Ratio - INSPIRATION AND EXHALATION RATIO**

I:E allows you to determine the ratio between the inspiratory breath phase duration and the exhalation breath phase duration.

I/T allows you to determine the ratio between the inspiratory breath phase duration and the total breath duration. (inhalation + exhalation)

**Note:**

Insp Time is not a setting and is displayed as Ti when the I:E or I/T ratio is adjusted.

### **I Sens – INSPIRATORY TRIGGER SENSITIVITY**

I Sens allows you to set the level of inspiratory effort the patient has to provide to initiate a machine breath.

The sensitivity levels decrease from 1P to 5: the lower the number, the more sensitive the trigger sensitivity. These levels correspond to differences in flow compared to the bias flow.

I Sens 1 (P) = Bias flow + (0.4 lpm to 1 lpm) (P = Pediatric use)

I Sens 2 = Bias flow + (0.7 lpm to 1.3 lpm)

I Sens 3 = Bias flow + (0.9 lpm to 1.5 lpm)

I Sens 4 = Bias flow + (1.0 lpm to 1.6 lpm)

I Sens 5 = Bias flow + (1.2 lpm to 1.8 lpm)

The bias flow consists of turbine flow through the patient circuit, during the exhalation phase, that helps the patient avoid rebreathing exhaled gas (CO<sub>2</sub>).

The inspiratory trigger is initiated after a time delay of between 700 ms to 1500 ms, depending on the preceding peak inspiratory flow. I Sens can be set to OFF.



#### **WARNING**

**The inspiration trigger threshold should be carefully modified in order to avoid the risk of false triggering or “autotriggering” of the ventilator. For example, Level 1P, the most sensitive mode, is recommended for pediatric use. However, for an adult, this setting may result in autotriggering.**

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### **Sigh VT**

A sigh is an increased volume of gas delivered to the patient at a set rate. i.e. every 50 breaths. The Vt multiplied by Sigh Vt gives the amount of volume delivered to the patient during a Sigh.

### **Sigh Rate**

Sigh Rate is the frequency with which Sigh breaths are delivered.

### **PIP (Min and Max Alarm Settings) – PEAK INSPIRATORY PRESSURE**

A minimum and maximum inspiratory pressure alarm threshold must be set.

The Min PIP (or Low Pressure) setting determines the trigger threshold for the “PATIENT DISCONNECTION” alarm. Refer to chapter 5, “Alarms and Troubleshooting”. If this pressure level is not reached during a fixed time, the alarm is triggered.



#### **WARNING**

**The setting of the LOW PIP alarm must be adjusted for the patient, but must also be set high enough to allow the “PATIENT DISCONNECTION” alarm to trigger properly. Perform the Low Pressure Test (refer to section F.1, “Low Pressure Test,” on page F-1) to ensure the LOW PIP alarm is properly set.**

---

The Max PIP or Max Pressure setting determines the level of pressure which is not to be exceeded during the inspiratory phase. Once this level is reached, inspiration is terminated, ventilation switches to exhalation, and a “High PIP” alarm is triggered. Refer to chapter 5, “Alarms and Troubleshooting”.

The difference between the Min PIP and Max PIP settings is limited to a minimum of 8 mbar.

This setting is also limited by the setting of PEEP; thus, the Min PIP setting must exceed the PEEP setting by at least 2 mbar. In addition, the Max PIP setting must exceed the PEEP setting by at least 10 mbar. A change in the PEEP level may lead to automatic changes in the Min PIP and/or Max PIP thresholds, in order to maintain these setting differences.

**VTE (Min and/or Max Alarm Settings) – EXPIRED TIDAL VOLUME**

Minimum and/or maximum expired tidal volume settings are adjustable, but can only be used with a double limb circuit configuration.

These thresholds can be set to trigger an alarm if the tidal volume expired by the patient is lower than the minimum threshold set ("LOW VTE" alarm) or greater than the maximum threshold set ("HIGH VTE" alarm). Refer to chapter 5, ["Alarms and Troubleshooting"](#).

Min VTE and Max VTE are linked to  $V_t$  so that  $V_t$  must be greater than Min VTE by at least 10 ml but lower than Max VTE by at least 10 ml.

If  $V_t$  is changed, Min VTE and Max VTE are automatically readjusted so that the difference between them is always maintained.

VTE is displayed when ventilating with an exhalation valve.

Setting Min VTE and Max VTE is not mandatory (they can be set to "OFF", which is the default setting), but the measured value is always displayed when using double limb configurations.

**Max Rtot (Max Alarm Setting) – TOTAL BREATH RATE**

The maximum rate threshold set monitors the risk of hyperventilation or ventilator autotriggering. Its setting is used to trigger the "HIGH RATE" alarm. Refer to chapter 5, ["Alarms and Troubleshooting"](#).

When set, the Max Rtot threshold must always exceed the Rate setting by at least 5 bpm. If the Rate is readjusted, the Max Rtot is automatically readjusted to maintain a minimum difference of 5 bpm.

Setting the Max Rtot is not mandatory (it can be set to "OFF", the default setting), but the measured value is always displayed.

**FIO2 (Min and/or Max Alarm Settings) - FRACTION OF INSPIRED OXYGEN**

An  $\text{FiO}_2$  sensor connected to the patient circuit allows you to determine that the correct level of oxygen is being delivered to the patient.

Min and Max  $\text{FiO}_2$  thresholds can be set to trigger "LOW  $\text{FIO}_2$ " or "HIGH  $\text{FIO}_2$ " alarms.

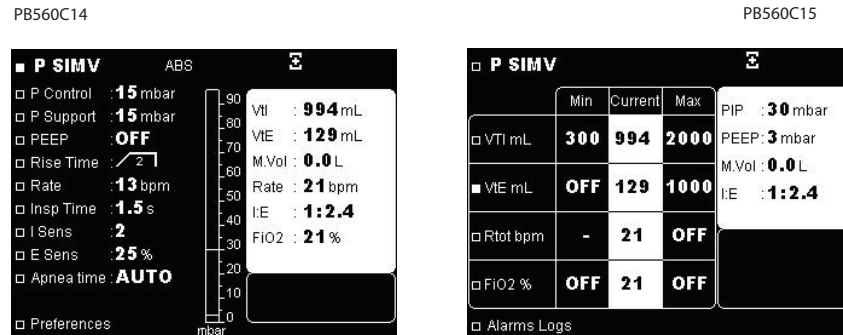
$\text{FiO}_2$  Min and  $\text{FiO}_2$  Max thresholds are related and their settings must maintain a minimum difference of 10% between the two.

Min and Max  $\text{FiO}_2$  settings can be set to OFF if an  $\text{FiO}_2$  sensor is not connected. Settings are automatically restored once a sensor is reconnected.

These settings are the same for all ventilation modes.

### 3.5 P SIMV Mode Parameters and Setting Ranges

The menus in the P SIMV (Synchronised Intermittent Mandatory Ventilation Pressure) ventilation mode are shown in [Figure 3-8](#).



**Figure 3-8.** Menus in P SIMV Ventilation Mode

[Table 3-9](#) shows the adjustable Ventilation parameters in P SIMV mode.

**Table 3-9.** Ventilation Parameters in P SIMV Ventilation Mode

Name	Units	Min. Value	Max. Value	Adjustment Resolution	Default Value	Linked Parameters
P Control	cmH <sub>2</sub> O, mbar or hPa	5	55	1	15	PEEP
P Support	cmH <sub>2</sub> O, mbar or hPa	5	55	1	15	PEEP
PEEP	cmH <sub>2</sub> O, mbar or hPa	OFF	20	1	OFF	P Support P Control PIP
Rate	bpm	1	40	1	13	Max Rtot Insp Time
Insp Time	s	0.3	2.4	0.1	1.5	Rate Vt Apnea Time
E Sens	%	5 (-95)	95 (-5)	5	25	-
I Sens	-	1P	5	1	2	-
Rise Time	-	1	4	1	2	-
Apnea Time	s	1	60	1	Auto	Backup R I:E (I/T)

[Table 3-10](#) shows the adjustable alarm parameters in P SIMV mode.

**Table 3-10.** Alarm Parameters in P SIMV Ventilation Mode

Name	Units	Min. Value	Max. Value	Adjustment Resolution	Default Value	Links
Min VTI	ml	30	2000	10	300	Max VTI

**Table 3-10.** Alarm Parameters in P SIMV Ventilation Mode (Continued)

Max VTl	ml	80	3000	10	2000	Min VTl
Min VTE	ml	30	1990	10	300	Max VTE
Max VTE	ml	80	3000	10	1000	Min VTE
Max Rtot	bpm	17	70	1	OFF	Rate
Min FiO2	%	18	90	1	OFF	Max FiO2
Max FiO2	%	30	100	1	OFF	Min FiO2

**P Control – PRESSURE CONTROL**

When Relative Pressure is set to YES in the Setup Menu, P Control allows you to determine inspiratory pressure added to PEEP during the inspiratory phase of controlled breaths.

In this configuration, the sum of P Control and PEEP must not exceed 55 mbar.

When Relative Pressure is set to OFF in the Setup Menu, P Control allows you to determine inspiratory Absolute pressure of controlled breaths.

In this configuration, P Control and PEEP are related and their settings must maintain a minimum difference between the two of 2 mbar in leak configuration and 5 mbar in valve configuration.

**P Support - PRESSURE SUPPORT**

When Relative Pressure is set to YES in the Setup Menu, P Support allows you to determine inspiratory pressure added to PEEP during the inspiratory phase of spontaneous breaths.

In this configuration, the sum of P Support and PEEP must not exceed 55 mbar.

When Relative Pressure is set to OFF in the Setup Menu, P Support allows you to determine inspiratory Absolute pressure of spontaneous breaths.

In this configuration, P Support and PEEP are related and their settings must maintain a minimum difference between the two of 2 mbar in leak configuration and 5 mbar in valve configuration.

**PEEP–POSITIVE END EXPIRATORY PRESSURE**

PEEP allows you to determine the level of pressure maintained during the exhalation phase.

When Relative Pressure is set to YES in the Setup Menu, the sum of P Control or P Support and PEEP must not exceed 55 mbar.

When relative pressure is set to OFF, P Control or P Support and PEEP are related and their settings must maintain a minimum difference between the two of 2 mbar in leak configuration and 5 mbar in valve configuration.

The ventilation mode can be adjusted without PEEP (PEEP is nearly 0 mbar when set to “OFF”) in valve configuration.

In leak configuration, the minimum PEEP setting is 4 mbar.

**Rate – RESPIRATORY RATE**

R-Rate is the rate at which the ventilator control pressure cycles are initiated, excluding apnea phases.

Rate and Insp Time are related so that if Rate is greater than 12 bpm, then Insp Time must be between 20% and 80% of the breath cycle duration as determined by Rate:

Insp Time <  $0.33 \times 60 / \text{R Rate}$  if Rate > 8.

Insp Time <= 2.4 if Rate < 8.

**Note:**

- During apnea ventilation, the ventilator delivers controlled breaths according to a backup rate (Backup R) as long as no inspiratory trigger has been detected.
- The Backup R value applied depends on the Rate setting. Hence, Backup R is at least equal to 8 bpm and is equal to the Rate value if Rate is greater than 8 bpm.

**Insp Time - INSPIRATORY TIME CONTROLLED**

Insp Time allows you to determine the duration of the inspiratory phase of controlled breaths triggered by the ventilator and is limited to a 1:2 I:E ratio.

Backup R and Insp Time are related.

**I Sens – INSPIRATORY TRIGGER SENSITIVITY**

I Sens allows you to set the level of inspiratory effort the patient has to provide to initiate a machine breath.

The sensitivity levels decrease from 1P to 5: the lower the number, the more sensitive the trigger sensitivity. These levels correspond to differences in flow compared to the bias flow.

I Sens 1 (P) = Bias flow + (0.4 lpm to 1 lpm) (P = Pediatric use)

I Sens 2 = Bias flow + (0.7 lpm to 1.3 lpm)

I Sens 3 = Bias flow + (0.9 lpm to 1.5 lpm)

I Sens 4 = Bias flow + (1.0 lpm to 1.6 lpm)

I Sens 5 = Bias flow + (1.2 lpm to 1.8 lpm)

The bias flow consists of turbine flow through the patient circuit, during the exhalation phase, that helps the patient avoid rebreathing exhaled gas (CO<sub>2</sub>).

The inspiratory trigger is initiated after a time delay of between 700 ms to 1500 ms, depending on the preceding peak inspiratory flow. I Sens can be set to OFF.



**WARNING**

**The inspiration trigger threshold should be carefully modified in order to avoid the risk of false triggering or “autotriggering” of the ventilator. For example, Level 1P, the most sensitive mode, is recommended for pediatric use. However, for an adult, this setting may result in autotriggering.**

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**Apnea Time**

Apnea time allows the user to monitor and detect interruptions to the patient's spontaneous breathing pattern. The ventilator declares apnea when no breath has been delivered by the time that the operator-selected apnea interval elapses.

The APNEA TIME adjustment range shall be 1 to 60 seconds. The ventilator shall enable the operator to set an auto-setting which shall automatically calculate the APNEA TIME according to the following: APNEA TIME = 60 / BACKUP R for PSV ST mode or 12 s for V SIMV and P SIMV modes.

The Apnea Time “AUTO” setting (in seconds) is calculated using the formula (Auto = Maximum value between 3 seconds and 60/Backup R or Auto = 30 if Backup R = OFF).

**Note:**

- During apnea ventilation, the ventilator delivers machine controlled breaths according to a backup rate (Backup R)—as long as no inspiratory trigger has been detected.
- The Backup R value applied depends on the Rate setting. Hence, Backup R is at least equal to 8 bpm and takes the Rate value if Rate is greater than 8 bpm.

**I Time (Min and Max Settings)**

The minimum (Min I Time) and maximum (Max I Time) duration of the inspiratory phase cannot be set in V SIMV or P SIMV mode. In both the V SIMV and P SIMV modes, the Min I Time defaults to a setting equal to RISE TIME + 300 ms and the Max I Time defaults to the lesser of 3 seconds or 30/Rate.

**Rise Time**

The Rise Time during the inspiratory phase can be set in P SIMV mode and the range is 1-5. The device is configured with a default Rise Time setting of two (2) (or a pressure rise time of 200 ms to 800 ms).

**E Sens – EXHALATION SENSITIVITY**

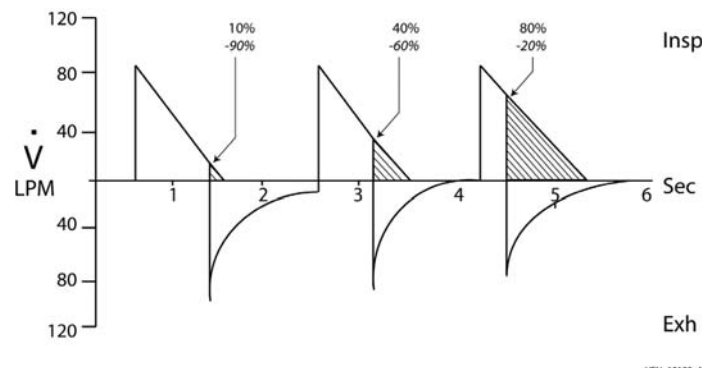
E sens is available in the P SIMV, V SIMV, and PSV modes. In CPAP, E Sens is defaulted to 25% and is not adjustable.

E Sens allows you to determine sensitivity of switching to exhalation and thus indirectly determines the inspiratory time of a breath.

The end of inspiration will occur when Inspiratory Flow has decreased to the preset E Sens setting.

The exhalation trigger is only taken into account after the Rise Time (which constitutes a default minimum inspiratory time) has elapsed.

If the flow drop is insufficient, exhalation is automatically triggered independently of the E Sens, which is defined as a percentage of peak inspiratory flow. Exhalation may be triggered if the maximum inspiratory time of three (3) seconds has elapsed, which corresponds to an I:E Ratio of 1:1.0, to ensure that the patient has enough time to exhale.



**Figure 3-9.** Exhalation trigger sensitivity

**Note:**

Refer to chapter 7, [“Operating Procedures”](#) for positive and *negative* E Sens settings.

**VTI (Min and/or Max Alarm Settings) – INSPIRATORY TIDAL VOLUME**

It is possible to set a Min and/or Max Tidal Volume alarm threshold for the patient’s inspired tidal volume.

This setting is used to trigger an alarm if the Tidal volume inspired by the patient is lower than the minimum threshold set ("LOW VTI" alarm) or greater than the maximum threshold set ("HIGH VTI" alarm). Refer to chapter 5, "Alarms and Troubleshooting".

Min VTI and Max VTI are related and their setting must maintain a minimum difference of 20 ml between them.

It is not mandatory to set the minimum and maximum VTI alarm limits. When the minimum and maximum VTI alarm limits are not set, the display will read "OFF" for these settings.

### **VTE (Min and/or Max Alarm Settings) – EXPIRED TIDAL VOLUME**

A Min and/or Max Tidal volume expired by the patient can be set but can only be used in a double limb circuit configuration.

These thresholds can be set to trigger an alarm if the Tidal volume expired by the patient is lower than the minimum threshold set ("LOW VTE" alarm) or greater than the maximum threshold set ("HIGH VTE" alarm). Refer to chapter 5, "Alarms and Troubleshooting".

Min VTE and Max VTE are related and their settings must be set to values that maintain a minimum difference of 20 ml between them.

VTE is displayed when ventilating with an exhalation valve.

Setting Min VTE and Max VTE is not mandatory (set to "OFF"), but the display of the measured value is always active in double limb configuration.

### **Max Rtot (Max Alarm Setting) – TOTAL BREATH RATE**

The maximum rate threshold set monitors the risk of hyperventilation or ventilator autotriggering. Its setting is used to trigger the "HIGH RATE" alarm. Refer to chapter 5, "Alarms and Troubleshooting".

When set, the Max Rtot threshold must always exceed the Rate setting by at least 5 bpm. If the Rate is readjusted, the Max Rtot is automatically readjusted to maintain a minimum difference of 5 bpm.

Setting the Max Rtot is not mandatory (it can be set to "OFF", the default setting), but the measured value is always displayed.

### **FIO<sub>2</sub> (Min and/or Max Alarm Settings) - FRACTION OF INSPIRED OXYGEN**

An FiO<sub>2</sub> sensor connected to the patient circuit allows you to determine that the correct level of oxygen is being delivered to the patient.

Min and Max FiO<sub>2</sub> thresholds can be set to trigger "LOW FIO<sub>2</sub>" or "HIGH FIO<sub>2</sub>" alarms.

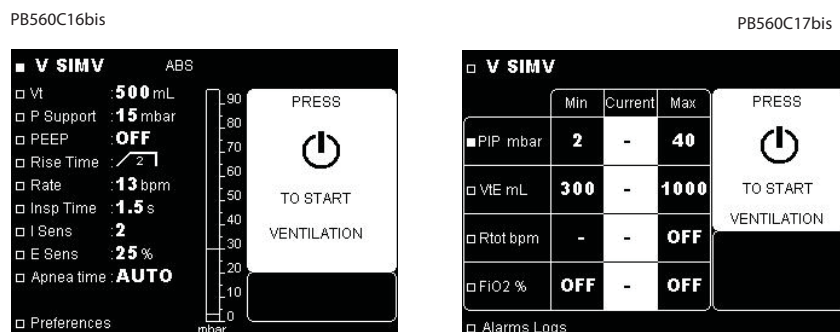
Min and Max FiO<sub>2</sub> thresholds are related and their settings must maintain a minimum difference of 10% between the two.

Min and Max FiO<sub>2</sub> settings can be set to OFF if an FiO<sub>2</sub> sensor is not connected. Settings are automatically restored once a sensor is reconnected.

These settings are the same for all ventilation modes.

## 3.6 V SIMV Mode Parameters and Setting Ranges

The menus in the V SIMV (Synchronised Intermittent Mandatory Ventilation Volume) ventilation mode are shown in [Figure 3-10](#).



**Figure 3-10.** Menus in V SIMV Ventilation Mode

[Table 3-11](#) shows the adjustments and limits in V SIMV mode.

**Table 3-11.** Ventilation Parameters in V SIMV Mode

Name	Units	Min. Value	Max. Value	Adjustment Resolution	Default Value	Links
Vt	ml	50	2000	10	500	Min VTE Max VTE Insp Time
P Support	cmH <sub>2</sub> O, mbar or hPa	5	55	1	15	PEEP Min PIP Max PIP
PEEP	cmH <sub>2</sub> O, mbar or hPa	OFF	20	1	OFF	P Support Max PIP Min PIP
Rate	bpm	1	40	1	13	Vt Max Rtot Insp Time
Insp Time	s	0.3	2.4	0.1	1.5	Vt Rate
E Sens	-	5 (-95)	95 (-5)	5	25	-
I Sens	-	1P	5	1	2	Rate
Rise Time	-	1	4	1	2	-
Apnea Time	s	1	60	1	Auto	Backup R

Alarm parameters that are adjustable in the V SIMV mode menu and their adjustment limits are listed in [Table 3-12](#).

**Table 3-12.** Alarm Parameters in the V SIMV Mode Menu

Name	Units	Min. Value	Max. Value	Adjustment Resolution	Default Value	Links
Min PIP	cmH <sub>2</sub> O, mbar or hPa	2	52	1	2	PIP PEEP Max PIP
Max PIP	cmH <sub>2</sub> O, mbar or hPa	12	60	1	40	PIP PEEP Min PIP
Min VTE	ml	30	1990	10	300	Vt Max VTE
Max VTE	ml	80	3000	10	1000	Vt Min VTE
Max Rtot	bpm	17	70	1	OFF	Rate
Min FiO <sub>2</sub>	%	18	90	1	OFF	Max FiO <sub>2</sub>
Max FiO <sub>2</sub>	%	30	100	1	OFF	Min FiO <sub>2</sub>

**Vt – VOLUME CONTROL**

Vt allows you to set the tidal volume delivered to the patient at each inspiration phase of intermittent or successive controlled breath cycles (triggered by the ventilator) in the event of patient apnea.

For physiological and safety reasons, the Vt setting is limited by the settings of Insp Time and Rate.

The ratio of Vt to Insp Time ( $Vt / \text{Insp Time}$ ) must be  $3 \text{ lpm} < (Vt * 60) / (60 / \text{Rate} * I/T) \text{ Insp Time} * 1000 < 100 \text{ lpm}$ .

**Note:**

The Backup R value applied depends on the Rate setting. Hence, Backup R is at least equal to 8 bpm and takes the Rate value if Rate is greater than 8 bpm.

**WARNING**

**Ensure that the patient circuit is appropriate for the tidal volume setting (tube Ø 22 mm for adults, and Ø 15 mm for pediatric tidal volumes lower than 200 ml).**

**P Support - PRESSURE SUPPORT**

When Relative Pressure is set to YES in the Setup Menu, P Support allows you to determine inspiratory pressure added to PEEP during the inspiratory phase of spontaneous breaths.

In this configuration, the sum of P Support and PEEP must not exceed 55 mbar.

When Relative Pressure is set to OFF in the Setup Menu, P Support allows you to determine inspiratory Absolute pressure of spontaneous breaths.

In this configuration, P Support and PEEP are related and their settings must maintain a minimum difference between the two of 2 mbar in leak configuration and 5 mbar in valve configuration.

**PEEP – POSITIVE END EXPIRATORY PRESSURE**

PEEP allows you to determine the level of pressure maintained during the exhalation phase.

When Relative Pressure is set to YES in the Setup Menu, the sum of P Support and PEEP must not exceed 55 mbar.

When relative pressure is set to OFF, P Support and PEEP are related and their settings must maintain a minimum difference between the two of 2 mbar in leak configuration and 5 mbar in valve configuration.

The ventilation mode can be adjusted without PEEP (PEEP is nearly 0 mbar when set to "OFF") in valve configuration.

In leak configuration, the minimum PEEP setting is 4 mbar.

### **Rate – RESPIRATORY RATE**

Rate is the rate at which ventilator controlled breaths are triggered, excluding apnea ventilation.

Rate and Insp Time are related so that if Rate is greater than 8 bpm, then Insp Time must be  $0.2 \times 60 / \text{Rate} < \text{Insp Time} < 0.8 \times 60 / \text{Rate}$

#### **Note:**

- During apnea, ventilation, the ventilator delivers controlled breaths according to a backup rate (Backup R) as long as no inspiratory trigger has been detected.
- The Backup R value depends on the Rate setting. Hence, Backup R is at least equal to 8 bpm and becomes equal to the Rate value if Rate is greater than 8 bpm.

### **Insp Time – INSPIRATORY TIME**

Insp Time allows you to determine the inspiratory phase duration of ventilator controlled breaths.

For physiological and efficiency reasons, its setting is limited by those of Vt and Rate.

The ratio Vt/Insp Time must be between 3 litres and 100 litres [ $3 < (Vt \times 60) / (\text{InspTime} \times 1000) < 100$ ].

#### **Note:**

The Backup R value depends on the Rate setting. Hence, Backup R is at least equal to 8 bpm and becomes equal to the Rate value if Rate is greater than 8 bpm.

### **I Sens – INSPIRATORY TRIGGER SENSITIVITY**

I Sens allows you to set the level of inspiratory effort the patient has to provide during the initiation of a machine breath.

The sensitivity levels decrease from 1P to 5: the lower the number, the more sensitive the trigger sensitivity. These levels correspond to differences in flow compared to the bias flow.

I Sens 1 (P) = Bias flow + (0.4 lpm to 1 lpm) (P = Pediatric use)

I Sens 2 = Bias flow + (0.7 lpm to 1.3 lpm)

I Sens 3 = Bias flow + (0.9 lpm to 1.5 lpm)

I Sens 4 = Bias flow + (1.0 lpm to 1.6 lpm)

I Sens 5 = Bias flow + (1.2 lpm to 1.8 lpm)

The bias flow consists of turbine flow through the patient circuit, during the exhalation phase, that helps the patient avoid rebreathing exhaled gas (CO<sub>2</sub>).

The inspiratory trigger is initiated after a time delay of between 700 ms to 1500 ms, depending on the preceding peak inspiratory flow.

**WARNING**

The inspiration trigger threshold should be carefully modified in order to avoid the risk of false triggering or “autotriggering” of the ventilator. For example, Level 1P, the most sensitive mode, is recommended for pediatric use. However, for an adult, this setting may result in autotriggering.

---

**Apnea Time**

Apnea time allows the user to monitor and detect interruptions to the patient's spontaneous breathing pattern. The ventilator declares apnea when no breath has been delivered by the time that the operator-selected apnea interval elapses.

The APNEA TIME adjustment range shall be 1 to 60 seconds. The Ventilator shall enable the operator to set an auto-setting which shall automatically calculate the APNEA TIME according to the following:  $APNEA\ TIME = 60 / BACKUP\ R$  for PSV ST mode or 12 s for V SIMV and P SIMV modes.

The Apnea Time “AUTO” setting (in seconds) is calculated using the formula (Auto = Maximum value between 3 seconds and  $60/Backup\ R$  or Auto = 30 if Backup R = OFF).


**Note:**

- During apnea ventilation, the ventilator delivers machine controlled breaths according to a backup rate (Backup R)—as long as no inspiratory trigger has been detected.
- The Backup R value applied depends on the Rate setting. Hence, Backup R is at least equal to 8 bpm and takes the Rate value if Rate is greater than 8bpm.

**I Time (Min and Max)**

The minimum (Min I Time) and maximum (Max I Time) duration of the inspiratory phase cannot be set in V SIMV or P SIMV mode. In both the V SIMV and P SIMV modes, the Min I Time defaults to a setting equal to RISE TIME + 300 ms and the Max I Time defaults to the lesser of 3 seconds or  $30/Rate$ .

**Ramp**

The distribution shape (or flow pattern) of the flow rate during the inspiratory phase cannot be set in V SIMV mode. The device is configured by default with a square wave flow pattern that represents a constant flow rate .

**Rise Time**

The Rise Time during the inspiratory phase can be set in V SIMV mode and the range is 1-5. The ventilator has a default Rise Time of 2 (or a pressure rise time of 400 ms).

**E Sens – EXHALATION SENSITIVITY**

E Sens is available in the P SIMV, V SIMV, and PSV mode. E Sens allows you to determine sensitivity of switching to exhalation and thus indirectly determines the inspiratory time of a breath.

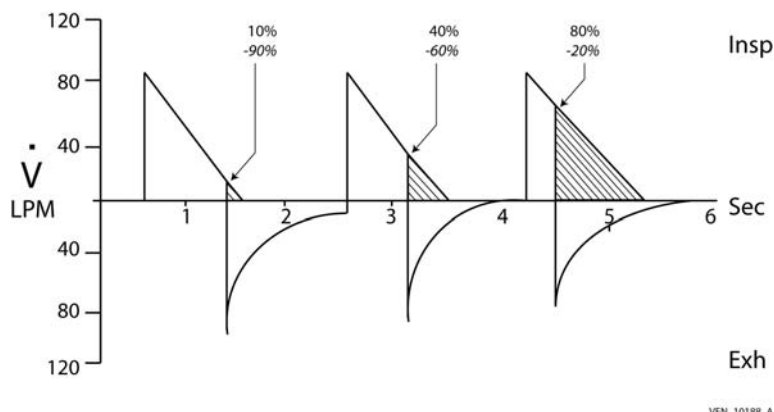
The end of inspiration will occur when Inspiratory Flow has decreased to the preset E Sens setting.

The exhalation trigger is only taken into account after the Rise Time (which constitutes a default minimum inspiratory time) has elapsed.

If the flow drop is insufficient, exhalation is automatically triggered independently of the E Sens, which is defined as a percentage of peak inspiratory flow. Exhalation may be triggered if the maximum inspiratory time of three (3) seconds has elapsed, which corresponds to an I:E Ratio of 1:1.0, to ensure that the patient has enough time to exhale.

**Note:**

Refer to chapter 7, “Operating Procedures” for positive and *negative* E Sens settings.



**Figure 3-11.** Exhalation trigger sensitivity

### PIP (Min and Max Alarm Settings) – PEAK INSPIRATORY PRESSURE

A minimum and maximum pressure alarm threshold must be set.

The Min PIP (or Min Pressure) setting determines the trigger threshold for the “PATIENT DISCONNECTION” alarm. Refer to chapter 5, “Alarms and Troubleshooting”.



#### **WARNING**

**The setting of the LOW PIP alarm must be adjusted for the patient, but must also be set high enough to allow the “PATIENT DISCONNECTION” alarm to trigger properly. Perform the Low Pressure Test (refer to section F.1, “Low Pressure Test,” on page F-1) to ensure the LOW PIP alarm is properly set.**

The Max PIP or Max Pressure setting determines the level of pressure which is not to be exceeded during the inspiratory phase. When this level is reached, inspiration is terminated, the device switches to exhalation, and a “High PIP” alarm is triggered. Refer to chapter 5, “Alarms and Troubleshooting”.

The difference between the Min PIP and Max PIP settings is limited to a minimum of 8 mbar. Their settings are also limited by that of PEEP; thus, Min PIP must be greater than PEEP by at least 2 mbar and Max PIP must be greater than PEEP by at least 10 mbar. A change in the PEEP level may lead to automatic changes in the Min PIP and/or Max PIP thresholds so that these differences are always maintained.

### VTI (Min and/or Max Alarm Settings) – INSPIRATORY TIDAL VOLUME

It is possible to set a Min and/or Max alarm threshold for the inspired tidal volume received by the patient.

VTI allows you to trigger an alarm during breath delivery if the tidal volume inspired by the patient is lower than the minimum threshold set (“LOW VTI” alarm) or greater than the maximum threshold set (“HIGH VTI” alarm). Refer to chapter 5, “Alarms and Troubleshooting”.

Min VTI and Max VTI are related to  $V_t$  such that  $V_t$  must be higher than Min VTI by at least 10 ml, but lower than Max VTI by at least 10 ml.

If  $V_t$  is changed, Min VTI and Max VTI are, if necessary, automatically readjusted so that the difference between them is maintained.

Setting Min VTI and Max VTI is not mandatory (set to “OFF”), but the display of the measured value is always active in a double limb configuration.

### **VTE (Min and/or Max Alarm Settings) – EXPIRED TIDAL VOLUME**

A double limb patient circuit configuration must be used when setting the Min and/or Max Tidal volume alarm limits.

These thresholds can be set to trigger an alarm if the Tidal volume expired by the patient is lower than the minimum threshold set ("LOW VTE" alarm) or greater than the maximum threshold set ("HIGH VTE" alarm). Refer to chapter 5, ["Alarms and Troubleshooting"](#).

Min VTE and Max VTE are linked to Vt such that Vt must be greater than Min VTE by at least 10 ml but lower than Max VTE by at least 10 ml.

If Vt is changed, Min VTE and Max VTE are, if necessary, automatically readjusted so that the difference between them is always maintained.

VTE is displayed when ventilating with an exhalation valve.

Setting Min VTE and Max VTE is not mandatory (each can be set to "OFF"), but the measured value is always displayed using a double limb patient circuit.

### **Max Rtot (Max Alarm Setting) – TOTAL BREATH RATE**

The maximum rate threshold set is used to monitor and alarm for ventilator autotriggering.

The alarm setting is used to trigger the "HIGH RATE" alarm. Refer to chapter 5, ["Alarms and Troubleshooting"](#).

When set, the Max Rtot threshold must always exceed the Backup Rate by 5 bpm; the Max Rtot is automatically readjusted to maintain a minimum difference of 5 bpm.

Setting the Max Rtot is not mandatory (it can set to "OFF"), but the measured value is always displayed.

### **FIO2 (Min and/or Max Alarm Settings) - FRACTION OF INSPIRED OXYGEN**

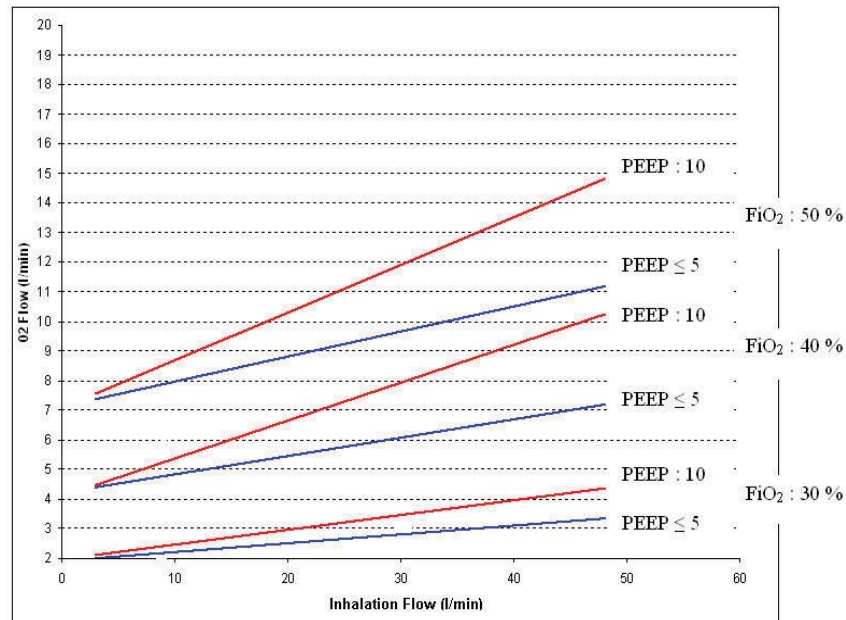
An FiO<sub>2</sub> sensor connected to the patient circuit allows you to determine that the correct level of oxygen is being delivered to the patient.

Min and Max FiO<sub>2</sub> thresholds can be set to trigger "LOW FIO2" or "HIGH FIO2" alarms.

Min FiO<sub>2</sub> and Max FiO<sub>2</sub> thresholds are related and their settings must maintain a minimum difference of 10% between the two.

Min and Max FiO<sub>2</sub> settings can be set to OFF if an FiO<sub>2</sub> sensor is not connected. Settings are automatically restored once a sensor is reconnected. These settings are the same for all ventilation modes.

### 3.7 FiO<sub>2</sub> For Various Oxygen and Ventilator Settings



Inhalation flow (LPM) = Volume (L) x 60 / Inspiratory time (S)

**Note:**

Tests conducted in a valve configuration. Results can vary according to whether the circuit is configured with or without a valve and patient lung characteristics.



**WARNING**

The Puritan Bennett™ 560 Ventilator can be used with an optional oxygen analyser with minimum and maximum concentration alarms. Always measure the delivered oxygen with a calibrated oxygen analyser (FiO<sub>2</sub> kit) that features a minimum and maximum concentration alarm in order to ensure that the prescribed oxygen concentration is delivered to the patient.

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## 4 Monitored Parameters

During ventilation, ventilator parameters measured or calculated are highlighted in the menus used for setting the ventilation parameters, the alarms, and the waveforms.

In addition to the display of monitored ventilation parameters, ventilation is displayed graphically, as follows:

- Pressure bar chart, in the ventilation parameters setting menu
- Pressure and flow rate waveforms, according to time, in the graphic menu (if waveforms was selected in the preferences menu). Refer to chapter 7, “Operating Procedures”.

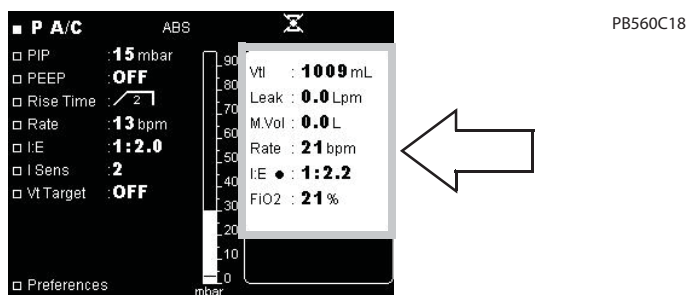
**Note:**

To monitor patient Oxygen levels use an external sensor/alarm.

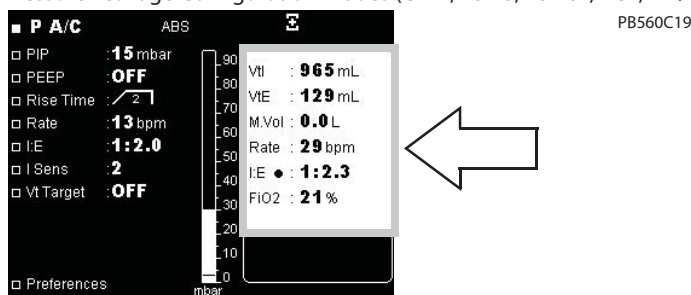
### 4.1 Digital Monitoring

The ventilation parameters monitored or calculated are highlighted in each of the main menus:

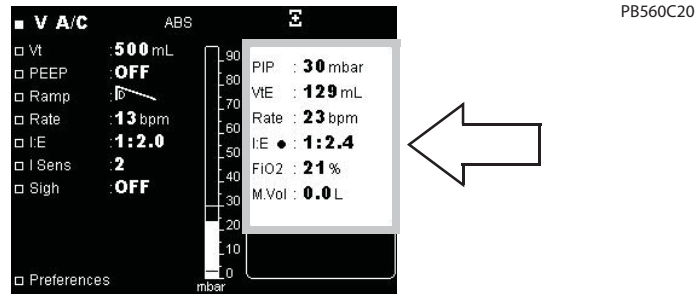
- Ventilation menu (Figure 4-1, Figure 4-2, Figure 4-3)
- Alarm menu (Figure 4-4, Figure 4-5, Figure 4-6)
- Waveform menu (Figure 4-7, Figure 4-8, Figure 4-9)



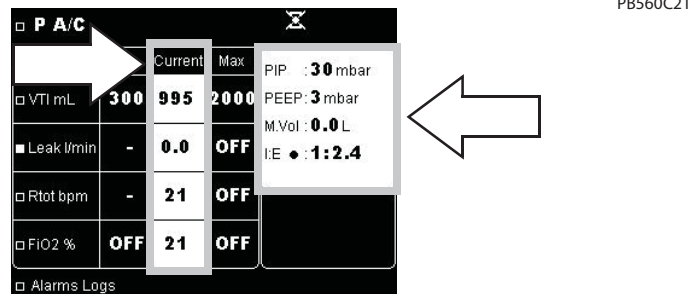
**Figure 4-1.** Ventilation Menu: Pressure Leakage Configuration Modes (CPAP, PSV S, PSV ST, PCV, P A/C)



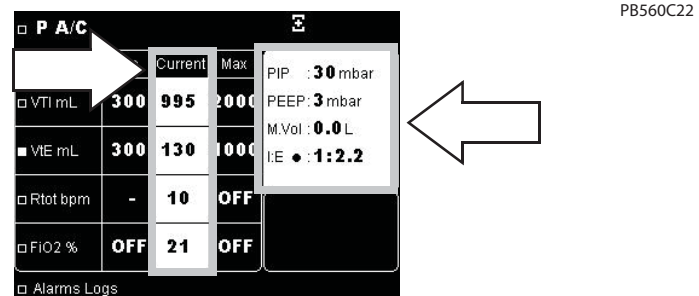
**Figure 4-2.** Ventilation Menu: Pressure Valve Configuration Modes (PSV S, PSV ST, PCV, P A/C)



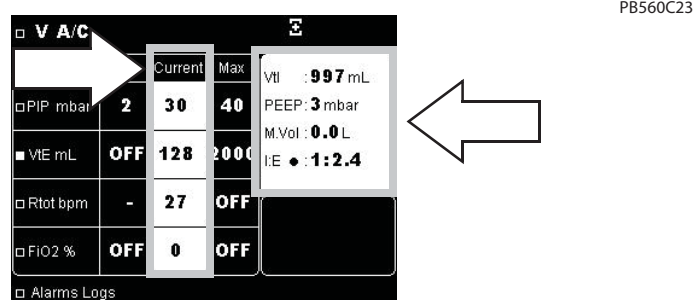
**Figure 4-3.** Ventilation Menu: Volume Mode (CV, V A/C, SIMV)



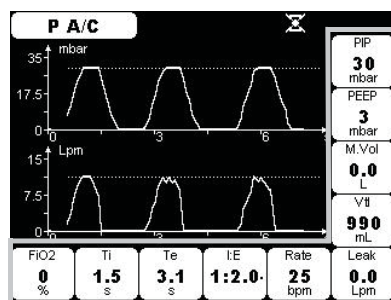
**Figure 4-4.** Alarm Menu: Pressure Leakage Modes (CPAP, PSV S, PSV ST, PCV, P A/C)



**Figure 4-5.** Alarm Menu: Pressure Valve Modes (PSV S, PSV ST, PCV, P A/C)

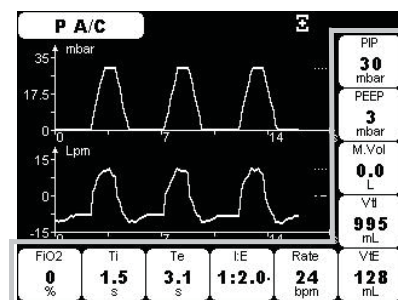


**Figure 4-6.** Alarm Menu: Volume Modes (CV, V A/C, SIMV)



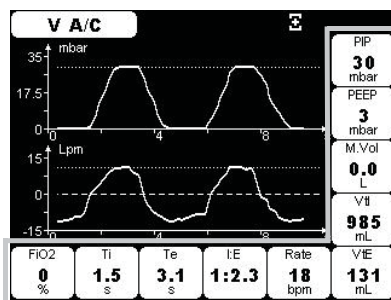
PB560C24

**Figure 4-7.** Waveform Menu: Pressure Leakage Modes (CPAP, PSV S, PSV ST, PCV, P A/C)



PB560C25

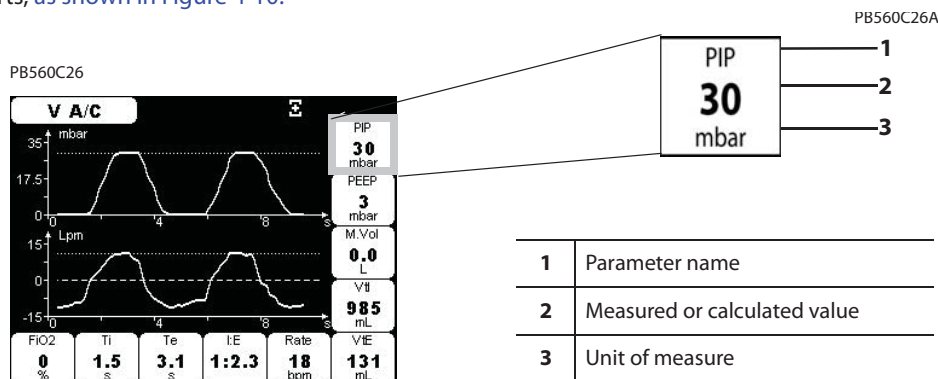
**Figure 4-8.** Waveform Menu: Pressure Valve Modes (PSV S, PSV ST, PCV, P A/C)



PB560C26

**Figure 4-9.** Waveform Menu: Volume Mode (CV, V A/C, SIMV)

Monitored parameter values are updated every two breath cycles and are displayed in the form of inserts, as shown in Figure 4-10.



PB560C26A

PB560C26

**Figure 4-10.** Monitored Parameter Inserts

If the monitored value for a parameter is not applicable or unavailable, the value is replaced by a hyphen “-” as shown in Figure 4-11.

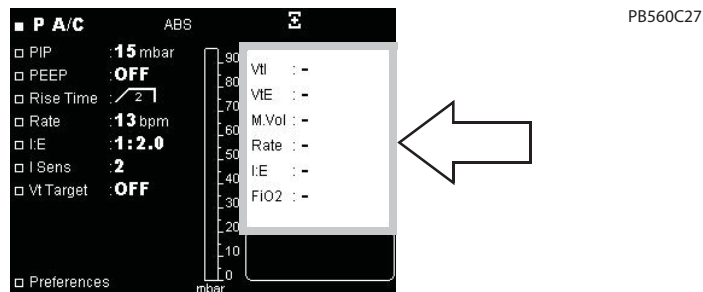



Figure 4-11. Display Showing Unavailable Parameter Values

### Inspiratory Trigger

During each inspiration phase triggered by the patient, the Inspiratory Effort Detected  symbol is displayed beside the cycling I:E ratio in the ventilation, alarm, or waveform menus (see Figure 4-12).

The patient triggers the ventilator by inhaling the amount of flow and the ventilator responds by delivering either a pressure-based or volume-based breath.

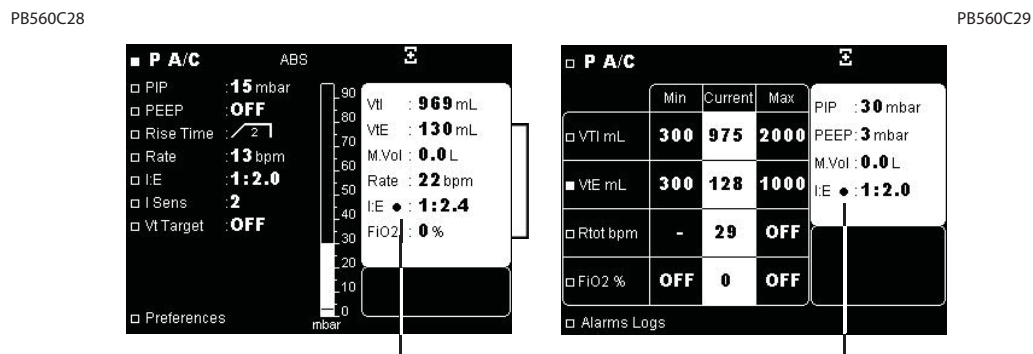


Figure 4-12. Inspiratory Effort Detected Indicator

### Displayed Monitored Parameters

Table 4-1. Displayed Monitored Parameters

Monitored Parameters	Display	Range	Description
Exhaled Tidal Volume	VTE	20 to 9999 ml	<p>Patient exhaled flow is measured by the exhalation flow transducer and that measurement is used to calculate volume (the flow transducers do not directly measure volume).</p> <p>The displayed value is updated at each inspiration, but is available only in the double limb patient circuit configuration.</p>
Exhalation Time	E Time	0 to 59.9 s	<p>Exhalation time measured.</p> <p>The displayed value (waveform only) is updated at each inspiration.</p>
Fraction of Inspired Oxygen	FIO2	0 to 99%	<p>Percentage of oxygen inspired by the patient.</p> <p>The displayed value (waveform only) is updated at each inspiration.</p>

**Table 4-1.** Displayed Monitored Parameters (Continued)

Monitored Parameters	Display	Range	Description
I:E Ratio	I:E	1:9.9 to 9.9:1	Ratio of inspiratory time measured to exhalation time measured. The displayed value is updated at each inspiration.
Inspiratory Tidal Volume	VTI	0 to 9999 ml	Flow delivered by the ventilator to the patient at each inspiratory phase is measured by the inspiratory transducer and that measurement is used to calculate volume (the flow transducers do not directly measure volume). The displayed value is updated at each inspiration. Currently when a Pressure Controlled or Pressure Support breath is delivered in valve ventilation and a leak is present, the ventilator will increase flow to reach the pressure target. The monitored VTI in Pressure Controlled or Pressure Support breaths reflects the amount of flow the ventilator delivers from the outlet port during inhalation. The monitored value will increase (possibly to an abnormally high number) when a leak is present. This displayed value is not what is delivered to the patient.
Inspiratory Time	I Time	0 to 9.9 s	Inspiratory time measured. The displayed value (only in waveform menu) is updated at each exhalation.
Leak	Leak	0 to 200 lpm	Available only in the single limb patient circuit in leak configuration. The displayed value (only in waveform menu) is updated at each inspiration.
Mean Airway Pressure	MAP	0 to 99 mbar	Average patient pressure during each breath. The displayed value is updated at each inspiration.
Minute Volume	M Vol	0 to 99.9 l	Flow delivered at each breath to the patient is measured by the inspiratory transducer and that measurement is used to calculate minute volume ( $V_t \times R_{tot}$ ) (the flow transducers do not directly measure volume). The displayed value is updated at each exhalation.
Peak Inspiratory Pressure	PIP	0 to 99 mbar	Highest circuit pressure during each inspiration phase measured with the proximal pressure sensor. The displayed value is updated at each exhalation.
Positive End Expiratory Pressure	PEEP	0 to 99 mbar	End exhalation pressure is measured by the proximal pressure sensor. The displayed value is updated at each inspiration
Rate	Rtot	0 to 99 bpm	Total number of breaths measured per minute. The displayed value is based on each breath and is updated at each inspiration.

## 4.2 Bargraph Display

In the ventilation menu, the highlighted bargraph dynamically displays pressures established throughout the breath cycle ([Figure 4-13](#)).

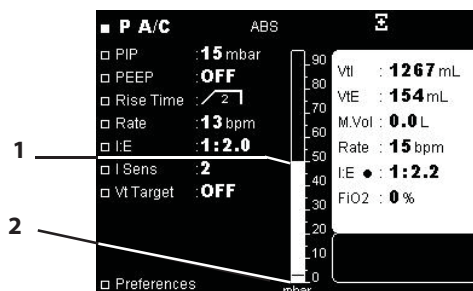



Figure 4-13. Bargraph Display

The PIP value reached during a cycle is represented by a line at the top of the bargraph (Figure 4-13, item 1) which remains displayed until the maximum value of the following cycle has been reached.

The PEEP value is represented by a line at the bottom of the bargraph (Figure 4-13, item 2).

### 4.3 Waveform Display

The waveform screen is only accessible during ventilation from the alarm parameters screen using the MENU  key. Its display has been configured in the Preferences menu (refer to chapter 7, "Operating Procedures").

- The Pressure waveform and the Flow waveform are referenced to Time. On these waveforms, the maximum Pressure and Flow lines are updated each time the graphic window is refreshed (every two breath cycles).
- The scales for Pressure and Flow automatically adjust according to the maximum levels measured over the last three cycles. The time scale also adjusts automatically according to the breath rate frequency, which allows the display of two consecutive cycles.

The waveform screen is shown in Figure 4-14.

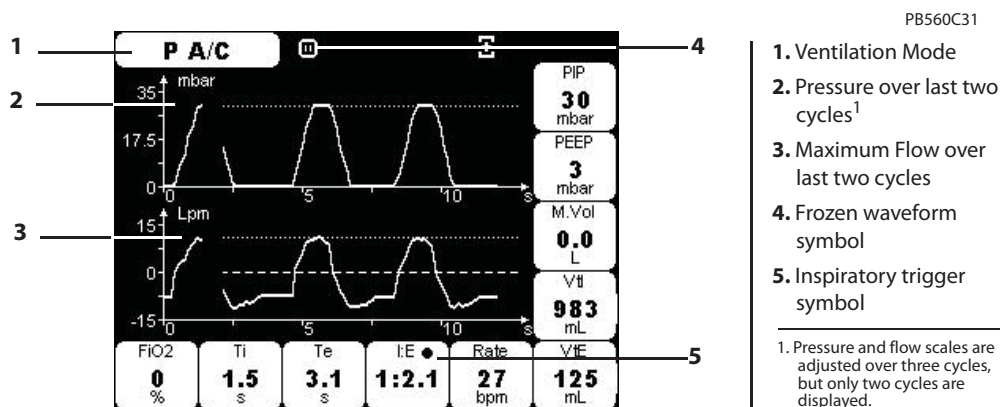



Figure 4-14. Waveform Screen

Waveform tracing can be frozen at any time, which enables the analysis of pressure and flow waveforms, while continuing patient ventilation.


**To freeze the waveform trace:**

Press the **DOWN**  key.

- The waveform display is frozen.
- The display of the last numerical monitored values remains fixed.
- The **Freeze Waveform**  symbol is displayed in the upper part of the screen.

**To unfreeze the waveform trace:**

Press the **UP**  key.

- Waveform tracing continues.
- The display of the numerical values monitored is refreshed.
- The **Freeze Waveform**  symbol disappears.

The Freeze Waveform function remains active even when changing the ventilation or alarm menu, or stopping ventilation. Accessing the Preferences Menu or the Alarm logs screen while the Freeze Waveform function is active deactivates this function.

**To dismiss the waveform screen manually:**

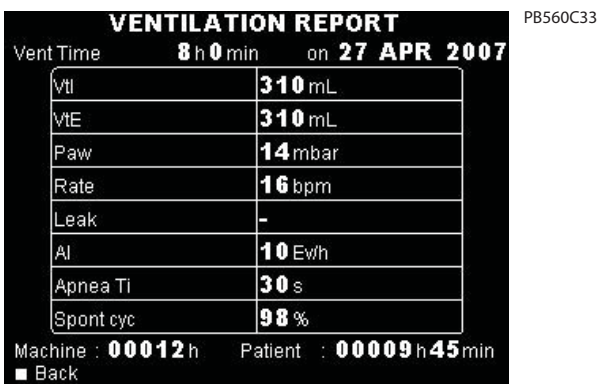
Press the **MENU**  key.

**The waveform screen is automatically dismissed:**

- When a High priority alarm is triggered.
- When you press the **VENTILATION ON/OFF**  key to stop ventilation.

## 4.4 Ventilation Report

The Ventilation Report is available in the Preferences Menu (refer to chapter 7, “[Operating Procedures](#)”). The Ventilation Report updates daily at 8am and shows the average readings from the previous 24 hours. Refer to [Figure 4-15](#)



**Figure 4-15.** Ventilation Report

**Note:**

The values displayed in the Ventilation Report are reinitialised when the software is updated or the patient counter is reset to zero.

**The following data is displayed in the Ventilation Report:**

**Vent Time - Ventilation Time**

The ventilation duration data is based on the patient counter and shows the total ventilation time in hours and minutes over the previous 24 hour period.

**VTI - Inspired Tidal Volume**

When ventilating with an exhalation valve, the VTI is the average inspired tidal volume during each ventilation cycle over the previous 24 hour period.

When ventilating in leak mode, the VTI is the average volume delivered by the ventilator during each ventilation cycle over the previous 24 hour period.

**VTE - Exhaled Tidal Volume**

When ventilating with a double limb circuit configuration and an exhalation valve, the VTE is the average exhaled volume during each ventilation cycle over the previous 24 hour period.

In a single limb circuit configuration this value is not measured.

**PAW - Peak Airway Pressure**

The Peak Airway Pressure is the average peak pressure during the inspiratory phase, measured by each cycle and over the previous 24 hour period.

**Rate - Respiratory Rate**

The Respiratory Rate is the average of the total respiratory frequency of the patient and the ventilator measured over the previous 24 hour period.

**Leak**

When ventilating with a leak configuration circuit, it is the average parasitic leak during each cycle and over the past 24 hour period. When ventilating with a single limb circuit there is no average leak.

**AI - Apnea Index**

The Apnea index is average number of apnea events per hour of ventilation. It is based on the Apnea Alarm.

**Apnea Ti - Apnea Time**

Accumulated apnea time over the previous 24 hour period.

**Spont Cyc - Spontaneous Cycling**

This is the percentage of ventilation cycles initiated by the patient and the ventilator over the previous 24 hour period.

**Machine**

Total time in hours that the ventilator has been switched on since manufacture.

**Patient**

Total time in hours and minutes that the current patient has been ventilated.



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## 5 Alarms and Troubleshooting

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**WARNING**

**Setting Alarm limits to extreme values can cause the ventilator alarms to malfunction.**

**When an alarm condition is triggered, or there is evidence of a patient-ventilator fault or problem, examine the patient first before examining the ventilator.**

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The alarms or faults generated by your Puritan Bennett™ 560 Ventilator are classified into two categories:

- Ventilation (or utilisation) alarms
- Technical faults

Some of the ventilator alarms are adjustable, depending on ventilation modes (refer to chapter 3, “[Operating Parameters](#)”). Automatic, non-adjustable alarms also exist to create a safety net for safer patient ventilation.

Alarms indicate events likely to affect the ventilation in the short term and necessitate rapid intervention (refer to section 5.8, “[Troubleshooting](#),” on page 5-15).

Technical faults do not directly affect machine operation. Therefore, the user is not alerted to technical faults. Only authorised and trained technicians may consult the maintenance menu (refer to the Puritan Bennett™ 560 Service Manual).

**Note:**

Default alarm setting preferences should be entered prior to using the ventilator.

### 5.1 Alarm Level of Priority

The alarm hierarchy for signalling the level of alarm criticality is listed below.

- **Very High Priority (VHP): Immediate critical situation; ventilation is impossible:**  
Continuous Sound Signaling / With or Without Continuous Red LED Illumination / With or Without Message / With or Without Display Lighting (it is possible for an alarm condition to occur that may not have **both** a message and lighting).
- **High Priority (HP): Critical situation in the short term; ventilation is potentially compromised:**  
High Speed Intermittent Sound Signaling / Flashing Red LED Illumination / With Message / With Display Lighting
- **Medium Priority (MP): Critical situation in the long term; ventilation is not affected in the short term:**  
Medium Speed Intermittent Sound Signaling / Flashing Yellow LED Illumination / With Message / With Display Lighting

**Note:**


There are currently no Low Priority (LP) Alarms.

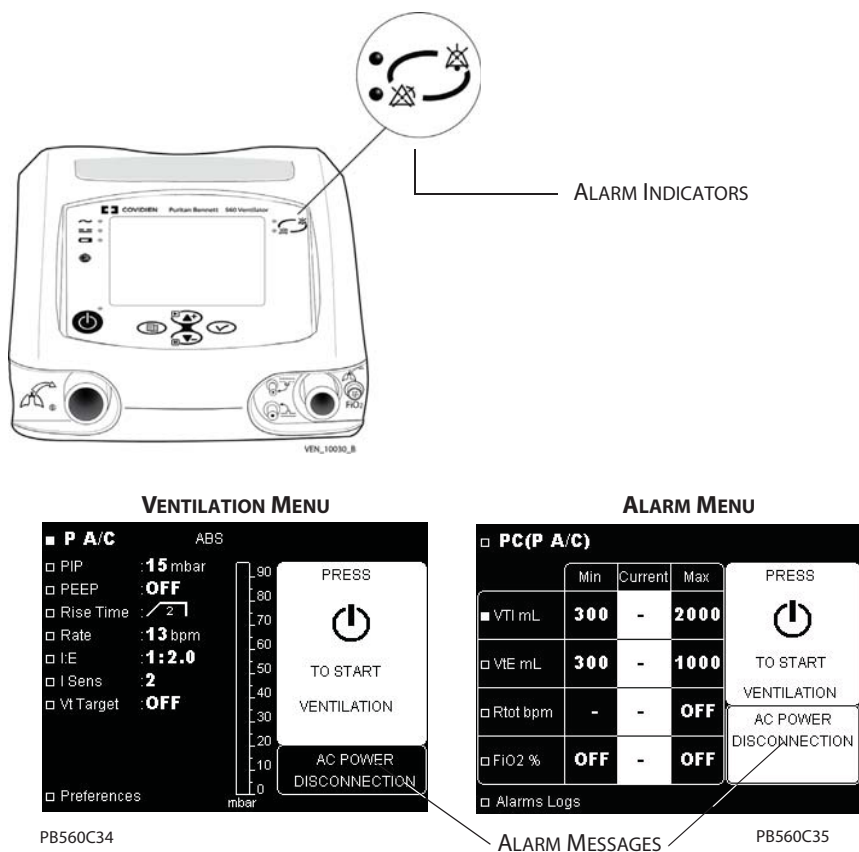
**Note:**

If there is no corrective action and if the audible alarm is not inhibited (Audio Paused) or reset (Alarm Reset) within 60 seconds, High Priority alarms will sound at the maximum level of 85 dB(A).

## 5.2 Alarm Display

During operation, when an alarm is activated:

- One of the red or yellow alarm indicators to the left of the **ALARM CONTROL**  key illuminates and flashes.
- An alarm tone sounds.
- A message is displayed and flashes in reverse video at the bottom of the Ventilation Menu or Alarm Menu.



**Figure 5-1.** Alarm Displays

**Note:**

There are currently no Low Priority (LP) Alarms.



When an alarm is triggered, if the current menu displayed is not the Ventilation parameters or Alarm menu, the display automatically switches to one of these menus to display the alarm message.

In the event several alarms are activated at the same time, the highest priority audible and visual alarm is highlighted; however, all active messages are displayed, in the sequence in which they occurred.

### 5.3 Alarm Logs Menu

All alarms are recorded in the internal memory of the ventilator at the time they are activated.  
The Alarm Logs menu is used to display the last eight (8) alarms activated, along with their date and time of activation.

To access the Alarm Logs menu, do the following:

- 1. Press the **MENU**  key to access the alarm setting menu (if this is not the menu currently displayed).
- 2. Press the **DOWN**  key several times or press until the cursor is on the "Alarm Logs" line at the bottom of the page. The display appears as follows:

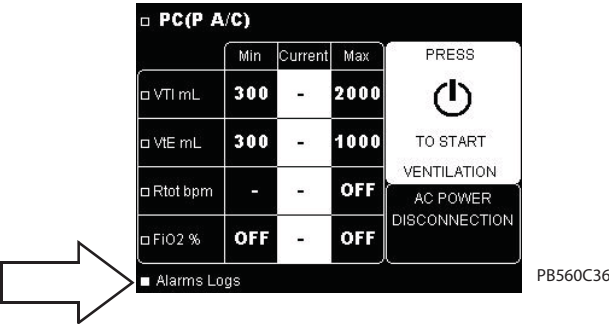


Figure 5-2. Accessing Alarm Logs Menu

- 1. Press the **ENTER**  key. The Alarm Logs screen is displayed.

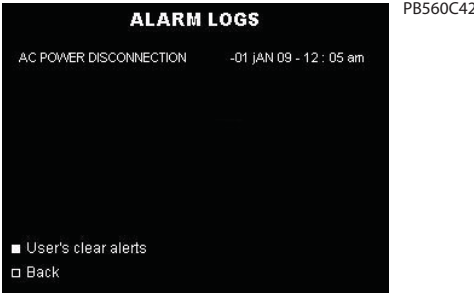


Figure 5-3. Displaying the Alarm Logs Screen

**Note:**  
When no alarm has been activated, "NO DATA" is displayed on the screen (see graphic below).



Figure 5-4. Alarm Logs Display when No Alarm Activated

For more information on the "USER'S CLEAR ALERTS" line, refer to section 5.6, "Re-activating Alarms," on page 5-5.

**To dismiss the Alarm Logs screen manually:**

Press the **ENTER**  key when the cursor is on the "Back" line.

**The Alarm Logs screen is dismissed automatically:**

- After 15 seconds if no keyboard action is detected
- When a High Priority alarm is triggered

**Note:**


Only qualified service personnel may access all alarms and events recorded by the ventilator. Qualified personnel should refer to the Puritan Bennett™ 560 Service Manual for further information.

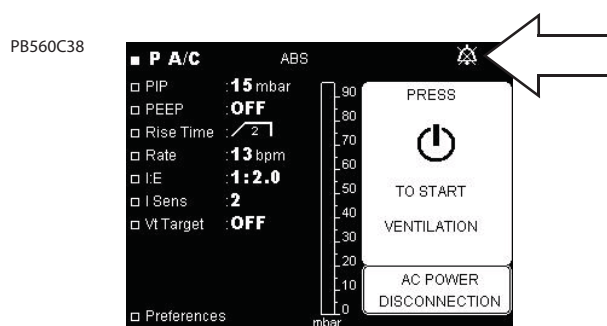
## 5.4 Silencing the Audible Portion of Alarms

You may silence the audible portion of alarms for 60 seconds at a time. This is referred to as the Audio Paused function.


**To silence the audible portion of activated alarms:**

Press the **ALARM CONTROL**  key.

- The audible portion of all activated alarms is paused.
- The visual portions (light indicator and message) of activated alarms remain visible.
- The Audio Paused symbol  is displayed at the top right of the screen while the audio pause function is active.



**Figure 5-5.** Silencing the Audible Portion of Alarms

If several alarms are activated at the same time, pressing the **ALARM CONTROL**  key affects all current alarms.

**The audible portion of activated alarms is automatically reactivated:**

- After 60 seconds, if the cause(s) of the alarm(s) persist(s)
- Whenever a new alarm is activated

**Note:**

If a key is stuck or held down for 45 seconds a keypad alarm will occur.

## 5.5 Pausing/Resetting Alarms



### WARNING


Alarm volume should be adjusted with respect to the ventilator's operating environment and so that the patient's caretakers can hear the alarms. The audible alarm vents located at the front of the device should never be obstructed. The alarm can be paused with the Alarm Pause function by pressing the ALARM CONTROL key twice once the alarm has been declared.

When an alarm condition is triggered, or there is evidence of a patient-ventilator fault or problem, examine the patient first before examining the ventilator.

Some alarms are not automatically cancelled when the condition causing the alarm clears e.g. HIGH PRESSURE. Some alarms can be paused manually even if the cause(s) of their activation remain(s).

### To manually pause an alarm, proceed as follows:

Press the **ALARM CONTROL**  key twice.

- The alarm is paused until the alarm condition is corrected and the condition reoccurs: the audible portion, light indicator, and message are all halted (for the alarms which can be paused manually).
- The Alarm Paused  symbol is displayed at the top right of the Ventilation, Alarms, and Waveforms screens. Refer to [Figure 5-6](#).

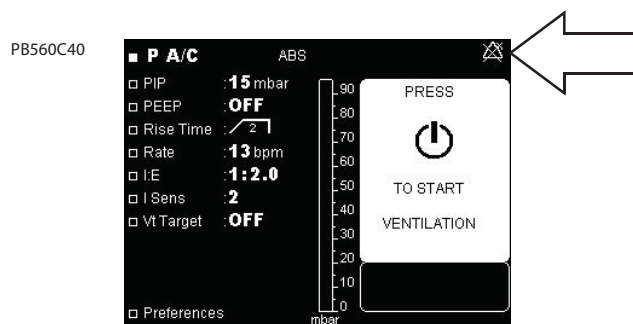


Figure 5-6. Manually Pausing Alarms

When no other alarms are currently activated, the last alarm cancelled is displayed continuously in the alarm message window in the Alarms menu, along with the date and time of its activation. The High Pressure alarm must be manually reset. Refer to section 5.7, "Overview of Alarms," on page 5-7.

### To manually reset the High Pressure Alarm, proceed as follows:

Press the **ALARM CONTROL**  key twice.


- The visual alarms will be reset.

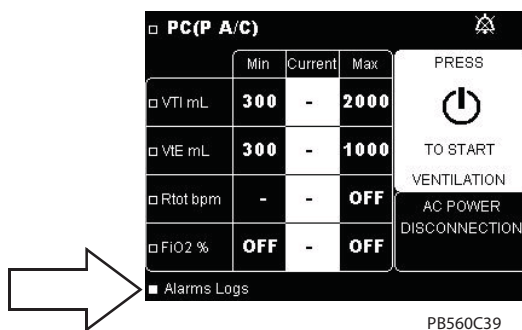
## 5.6 Re-activating Alarms

Alarms that have been paused and whose activation conditions continue to exist can be reactivated.



### To reactivate alarms, proceed as follows:

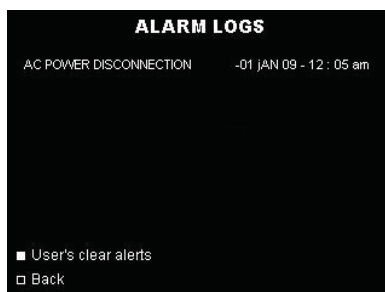
- Press the **MENU**  key to access the Alarm Setting menu, if this is not the menu currently displayed.

- Press the **DOWN**  key to position the cursor on the "Alarm Logs" line, if this is not already the case. Refer to the following graphic:






**Figure 5-7.** Reactivating Alarms

- Press the **ENTER**  key, to confirm access to the "Alarm Logs" menu.
- Press the **UP**  key to position the cursor on the "USER'S CLEAR ALERTS" line. Refer to the following graphic:



**Figure 5-8.** Alarm Logs

- Press the **ENTER**  key for at least three (3) seconds. The following events occur:
  - A "beep" sounds.
  - An audible alarm sounds.
  - An alarm indicator illuminates.
  - The messages of all active alarms are displayed in a loop in the Ventilation and Alarm menus.
  - The Audio Paused symbol  disappears (if it was displayed).
  - The Alarm Paused symbol  disappears.

## 5.7 Overview of Alarms

**Note:**

The message: “\*IF PERSISTS RESTART/SRVC” will occur only if the alarm condition continues for longer than 30 seconds.

**Table 5-1.** Overview of Alarms

Alarm Message	Cause/Ventilator Response	Priority	Audio Paused Avail.	Alarm Paused Avail.
AC POWER DISCONNECTION	<p>Cut-off of the AC (mains) power supply.</p> <p>Alarm activation occurs:</p> <ul style="list-style-type: none"> <li>After 5 seconds if ventilation is stopped</li> <li>At the start of a ventilation cycle when ventilation is in progress.</li> </ul> <p>Consequence: switch over to external DC power supply if present, otherwise to the internal battery.</p>	MP	Yes	Yes
APNEA	<p>No inspiratory trigger detected by the ventilator after the apnea time set in PSV, CPAP, P SIMV and V SIMV modes.</p> <p>Automatically clears itself after two successive patient breaths.</p>	MP	Yes	Yes – except for CPAP
BATTERY FAULT1 RESTART/SRVC	<p>Ventilator has detected an internal battery fault.</p> <p>Consequence: the internal battery is disabled from use.</p>	MP	Yes	No
BATTERY FAULT2 RESTART/SRVC	<p>No internal battery detected.</p>	MP	Yes	No
BUZZER LOW BATTERY	<p>Occurs when the buzzer battery is too low to sound the POWER SUPPLY LOSS alarm.</p>	MP	Yes	Yes
BUZZER FAULT1 RESTART/SRVC	<p>Defective operation of the buzzers.</p>	MP	Yes	No
BUZZER FAULT2 RESTART/SRVC	<p>Failure detected in the Very High Priority buzzer.</p> <p>Consequence: no audible alarm in case of POWER SUPPLY LOSS alarm.</p>	MP	Yes	Yes
BUZZER FAULT3 RESTART/SRVC	<p>Battery Charge Failure due to incorrect voltage. Contact your service representative for assistance.</p>	HP	Yes	No

**Table 5-1.** Overview of Alarms (Continued)

Alarm Message	Cause/Ventilator Response	Priority	Audio Paused Avail.	Alarm Paused Avail.
BUZZER FAULT4 RESTART/SRVC	Buzzer Battery Failure. The Battery Buzzer Voltage is too low.  Internal technical problem that prevents the battery sounding the POWER SUPPLY LOSS alarm.	MP	Yes	Yes
CALIBRATE FIO2	An FiO <sub>2</sub> sensor is detected and has not been calibrated.	MP	Yes	Yes
CALIBRATION FAIL	Failure of one calibration point of the internal exhaled flow sensor.  Consequence: failed calibration point is replaced by the default point.	MP	Yes	Yes
CHECK BATTERY CHARGE IF PERSISTS RESTART/SRVC	Internal battery charging failure. Consequence: charging of the internal battery impossible.	MP	Yes	Yes
CHECK EXH VALVE* *IF PERSISTS RESTART/SRVC	Inspired tidal volume during exhalation < 20% of Inspired tidal volume and Inspired tidal volume > 20mL.  Exhalation valve obstructed.	HP	Yes	No
CHECK EXH VALVE PRESSURE	Internal ventilation fault related to exhalation valve detection sensor. (pressure sensor)	HP	Yes	Yes
CHECK FIO2 SENSOR	FiO <sub>2</sub> measurement is less than 18%.  Recalibrate or change FiO <sub>2</sub> sensor.	HP	Yes	No
CHECK PROXIMAL LINE1* *IF PERSISTS RESTART/SRVC	1. Loss of signal from the proximal pressure sensor  Consequence: switch to internal pressure sensor for the pressure measurement. Alarm activation occurs: In the event of signal loss (1): After one ventilation cycle or In the event of signal loss (2) and after the 17 <sup>th</sup> breath cycle: After 17 seconds for PA/C and V A/C modes, or after the maximum time between 17 seconds and Apnea Time + 4 seconds for CPAP, PSV, P SIMV, and V SIMV modes	MP	Yes	No


**Table 5-1.** Overview of Alarms (Continued)

Alarm Message	Cause/Ventilator Response	Priority	Audio Paused Avail.	Alarm Paused Avail.
CHECK REMOTE ALARM	No activation of Nurse Call or remote alarm system when an alarm is in progress.	MP	Yes	Yes
CHECK SETTINGS	Alarm activation occurs: <ul style="list-style-type: none"> <li>Systematically after software versions have changed.</li> <li>Loss of memorised parameters</li> </ul> Consequence: <ul style="list-style-type: none"> <li>Locking Key disabled</li> <li>Out-of-range settings are replaced by their default values</li> </ul>	MP	Yes	Yes
CONNECT VALVE OR CHANGE PRESS	No exhalation valve connected with PEEP set to less than 4 mbar or PIP set to more than 30 mbar when relative pressure is set to OFF.	HP	Yes	No
CONTROLLED CYCLES	The ventilator is delivering apnea ventilation at set back up rate.	NA	No	No
COOLING FAN RESTART/SRVC	Ventilator cooling fan operating speed not suited to the internal ambient temperature of the device.	MP	Yes	Yes
DC POWER DISCONNECTION	Cut-off of the external DC power supply. Consequence: switch-over to the internal battery.	MP	Yes	Yes
DEVICE FAULT3 RESTART/SRVC	Failure in the 24 V power supply.	HP	Yes	No
DEVICE FAULT5 RESTART/SRVC	Detection of a fault in the electrical power supply system. Consequence: the internal battery capacity is not displayed beside the battery symbol.	MP	Yes	Yes
DEVICE FAULT7 RESTART/SRVC	Detection of a fault in internal voltage measurement.	HP	Yes	No
DEVICE FAULT9 RESTART/SRVC	POST RAM Error. RAM Read/Write does not match memory setting.	VHP	No	No

**Table 5-1.** Overview of Alarms (Continued)

Alarm Message	Cause/Ventilator Response	Priority	Audio Paused Avail.	Alarm Paused Avail.
DEVICE FAULT10 RESTART/SRVC	POST FLASH Checksum Error. Startup FLASH computed checksum does not match memory setting.	VHP	No	No
DEVICE FAULT11 RESTART/SRVC	POST EEPROM Error. Startup EEPROM does not match memory setting.	VHP	No	No
DEVICE FAULT12 RESTART/SRVC	POST Reference Voltage Error. 5V or 10V reference voltage error.	VHP	No	No
DEVICE FAULT13 RESTART/SRVC	Software Version Error	VHP	No	No
E SENS FAULT OR CIRC LEAK	At least four of the last six spontaneous breaths are terminated by time.	MP	Yes	No
EMPTY BATTERY	Internal battery capacity < 10 min. or 3%. (battery voltage < 22.5V) Consequence: ventilation comes to a halt.	HP	No	No
EXH VALVE LEAKAGE	Abnormally high expired flow during the inspiratory phase of three consecutive breaths (in double-limb setup). Alarm activation occurs: After three consecutive breaths.	MP	Yes	No
FIO2 SENSOR MISSING	No FiO <sub>2</sub> sensor detected and the FiO <sub>2</sub> alarm is active.	HP	Yes	Yes
HIGH / LOW BATTERY TEMP* *IF PERSISTS RESTART/SRVC	Battery temperature out of tolerance. Consequence: battery charging stops.	MP	Yes	Yes
HIGH FIO2	The level of oxygen delivered by the ventilator exceeds the Max FIO2 level set.	MP	Yes	No
HIGH INT TEMP COOL VENT* *IF PERSISTS RESTART/SRVC	Device internal ambient temperature out of tolerance range.	MP	Yes	Yes
HIGH LEAKAGE	The LEAK estimated by the ventilator exceeds the Max LEAK alarm threshold.	MP	Yes	No

**Table 5-1.** Overview of Alarms (Continued)

Alarm Message	Cause/Ventilator Response	Priority	Audio Paused Avail.	Alarm Paused Avail.
HIGH PRESSURE	<ul style="list-style-type: none"> <li>In V A/C or V SIMV modes, if Inspiratory Pressure is higher than Max PIP during three consecutive cycles.</li> <li>or</li> <li>In PSV, CPAP, P A/C, or P SIMV modes, if Inspiratory Pressure is higher than (P Support or P Control + PEEP) + 5 mbar up to 29 mbar or + 10 mbar over 30 mbar during three consecutive cycles.</li> <li>or</li> <li>In PSV or CPAP mode and P Support is set to off, if Inspiratory Pressure is higher than PEEP + 10 mbar during three consecutive cycles.</li> </ul> <p>Alarm activation occurs:</p> <ul style="list-style-type: none"> <li>After three consecutive breaths.</li> </ul> <p>Consequence:</p> <ul style="list-style-type: none"> <li>Switch to exhalation phase.</li> </ul>	<p>HP</p> <p>Note: When alarm condition clears, alarm priority indicator must be manually reset by pressing the  key.</p>	Yes	No (The visual portion of the alarm may be paused)
HIGH RATE	<p>Rate measured greater than Max Rtot set during three consecutive breaths.</p> <p>Alarm activation occurs:</p> <ul style="list-style-type: none"> <li>After three consecutive breaths.</li> </ul>	MP	Yes	No
HIGH VTE	<p>Expired tidal volume greater than Max VTE set during three consecutive breaths (in double limb setup).</p> <p>Alarm activation occurs:</p> <ul style="list-style-type: none"> <li>After three consecutive breaths.</li> </ul>	MP	Yes	No
HIGH VTI	<p>Inspired tidal volume greater than Max VTI set during three consecutive breaths in PSV, CPAP, P A/C, P SIMV, and V SIMV modes.</p> <p>Alarm activation occurs:</p> <ul style="list-style-type: none"> <li>After three consecutive breaths.</li> </ul>	HP	Yes	No
INSP FLOW RESTART/SRVC	<p>Inspiratory flow is constant (+/- 1 lpm) with normal turbine temperature and speed conditions. Contact your service representative for assistance.</p>	HP	Yes	No

**Table 5-1.** Overview of Alarms (Continued)

Alarm Message	Cause/Ventilator Response	Priority	Audio Paused Avail.	Alarm Paused Avail.
INTENTIONAL VENT STOP	Ventilation has been stopped voluntarily by the caregiver or patient.	HP	Yes	Yes
KEYPAD FAULT RESTART/SRVC* *IF PERSISTS RESTART/SRVC	Keyboard key held down for more than 45 seconds.	HP	No	No
LOW BATTERY	Internal battery capacity < 30 min. or 8%.	HP	Yes	No
LOW FIO2	The level of oxygen delivered by the ventilator is below the Min FiO <sub>2</sub> level set.	MP	Yes	No
LOW VTE	Expired tidal volume less than Min VTE set during three consecutive breaths (in double-limb setup). Alarm activation occurs: <ul style="list-style-type: none"> <li>After three consecutive breaths.</li> </ul>	MP	Yes	No
LOW VTI	Inspired tidal volume less than Min VTI set during three consecutive breaths in PSV, CPAP, P A/C, P SIMV and V SIMV modes. Alarm activation occurs: <ul style="list-style-type: none"> <li>After three consecutive breaths.</li> </ul>	MP	Yes	No
NO PROXIMAL LINE2* *IF PERSISTS RESTART/SRVC	Proximal pressure < 0.6 mbar for 100 ms during inspiration phase of 3 <sup>rd</sup> breath cycle Ventilator response: Switch to internal pressure sensor for pressure measurement.	MP	Yes	No
OCCLUSION CHECK CIRCUIT* *IF PERSISTS RESTART/SRVC	Tidal volume measured negligible during three consecutive breaths for PSV, CPAP, P A/C and P SIMV modes. Alarm activation occurs: <ul style="list-style-type: none"> <li>After three consecutive breaths.</li> </ul>	HP	Yes	No
OCCLUSION CHECK CIRCUIT	Occurs in LEAK configuration when the LEAK level is not sufficient to flush the CO <sub>2</sub> from patient exhalation. The built-in LEAK in the mask may be obstructed. The built-in leak for the mask is or not sufficient for the settings.	HP	Yes	No

**Table 5-1.** Overview of Alarms (Continued)

Alarm Message	Cause/Ventilator Response	Priority	Audio Paused Avail.	Alarm Paused Avail.
PATIENT DISCONNECTION* *IF PERSISTS RESTART/SRVC	Alarm activation occurs if conditions remain for the maximum time between: <ul style="list-style-type: none"> <li>disconnection time and 60/R-Rate in P A/C and V A/C mode</li> <li>disconnection time and (Apnea time +2 sec) in CPAP and PSV mode</li> <li>disconnection time and (60/R-Rate + Insp time) in P SIMV and V SIMV mode.</li> </ul>	HP	Yes	No
	If the flow is greater than 130 lpm during the inspiratory phase.			
	In V A/C and V SIMV modes, if patient pressure is lower than Min PIP.			
	In PSV, CPAP, P A/C modes and P SIMV if patient pressure is lower than (P Support + PEEP) - 20% or (P Control + PEEP) - 20%.			
POWER FAULT RESTART/SRVC	Detection of a fault in the electrical power supply system.	MP	Yes	Yes
POWER SUPPLY LOSS (no message)	1. Electrical power supply to the machine is interrupted with the I/O switch when ventilation is in progress or 2. Battery fully discharged when it was the only source of power to the ventilator. Consequence: ventilation stops immediately. Ventilation restarts immediately when the switch is pressed in case 1 (above) or after restoration of the AC or DC supply in case 2 (above).	VHP	No	Yes
PRES SENS FLT1 RESTART/SRVC	Faulty internal pressure sensor signal. Alarm activation occurs: <ul style="list-style-type: none"> <li>After 15 seconds.</li> </ul>	HP	Yes	No
PROX SENS FLT2 RESTART/SRVC	Faulty proximal pressure sensor signal. Alarm activation occurs: <ul style="list-style-type: none"> <li>After 15 seconds.</li> </ul>	MP	Yes	Yes
REMOVE VALVE CPAP MODE	The ventilation settings are not compatible with the type of patient circuit used. Remove exhalation valve to start CPAP ventilation.	HP	Yes	No

**Table 5-1.** Overview of Alarms (Continued)

<b>Alarm Message</b>	<b>Cause/Ventilator Response</b>	<b>Priority</b>	<b>Audio Paused Avail.</b>	<b>Alarm Paused Avail.</b>
REMOVE VALVE OR CHANGE PRES	The ventilation settings are not compatible with the type of patient circuit used. With a valve circuit, the difference between PIP and PEEP should not be less than 5 mbar.	HP	Yes	No
SOFTWARE VERSION ERROR	Detection of a wrong software version.	NA	NA	NA
TURB OVERHEAT RESTART/SRVC	Turbine speed too low and temperature too high. Consequence: ventilation stops immediately and O <sub>2</sub> supply stops.	HP	No	No
UNKNOWN BATTERY	The internal battery is not recognised as a Puritan Bennett™ product battery.	MP	Yes	No
VALVE MISSING CONNECT VALVE	Connect exhalation valve to start ventilation in V A/C or V SIMV / P SIMV modes.	HP	Yes	No
VTI NOT REACHED* *IF PERSISTS RESTART/SRVC	Measurement and calculation of tidal volume do not match Vt set during six consecutive breaths in VOL inspired and V SIMV modes. Alarm activation occurs: <ul style="list-style-type: none"> <li>After six consecutive breaths—once the ventilator has reached its performance limits.</li> </ul>	HP	Yes	No

## 5.8 Troubleshooting



### WARNING

This manual tells you how to respond to ventilator alarms, but it does NOT tell you how to respond to the patient.

To ensure proper servicing and avoid the possibility of physical injury to personnel or damage to the ventilator, only personnel authorised and qualified by Covidien should attempt to service or make authorised modifications to the Puritan Bennett™ 560 Ventilator.

### 5.8.1 Alarms

Table 5-2 offers a guide to the most likely ventilator alarms, possible reasons for the alarms, and corrective actions.



### WARNING

Except for replacing the internal battery and performing the recommended maintenance described in Chapters 8 through 10 of this manual, do not try to repair or otherwise service the ventilator yourself, or modify the ventilator, its components, or accessories. Doing so might endanger the patient, cause damage to the ventilator, and/or void your warranty. Only qualified service personnel should attempt repair of the ventilator.

When an alarm condition is triggered, or there is evidence of a patient-ventilator fault or problem, examine the patient first before examining the ventilator.

### Note:

The ventilator screen must be unlocked before setting and parameters can be changed.

**Table 5-2.** Alarms and Corrective Actions

Alarm Message or Symptom	Possible Reason(s) For The Alarm Event	Corrective Action(s)
AC POWER DISCONNECTION	AC ("mains") power source cut off.	Cancel the alarm then check the supply cable and/or the effective availability of a voltage on the AC power ("mains") port. Cancel the alarm then check the power cable availability of a voltage on the AC power ("mains") outlet.
	Starting with 12 – 30 VDC external power supply.	Cancel the alarm.
	Current-limiting fuse of the device blown.	Replace the ventilator and call for the maintenance technician.
APNEA	Patient's breathing effort less than the Sensitivity control setting.	Ensure the patient is breathing and adjust the inspiratory setting appropriately based on patient's respiratory needs.
	Patient apnea.	Examine the patient for breathing effort and stimulate if necessary. If patient status has changed adjust the ventilator settings based on patient's respiratory needs.
	Defective sensors.	Have a qualified technician replace the defective component(s) and call your customer service representative.
BATTERY FAULT1 RESTART/SRVC	Battery problem that prevents it from operating.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.

**Table 5-2.** Alarms and Corrective Actions (Continued)

Alarm Message or Symptom	Possible Reason(s) For The Alarm Event	Corrective Action(s)
BATTERY FAULT2 RESTART/SRVC	Internal battery missing or not detected.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
BUZZER FAULT1 RESTART/SRVC	Defective operation of the buzzers. Consequence: no audible tone when an alarm is activated.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
BUZZER FAULT2 RESTART/SRVC	Internal technical problem that prevents the very high priority "POWER SUPPLY LOSS" alarm from triggering.	Ensure that the protective cover over the I/O switch located on the rear of the device is intact and functioning properly. This cover helps prevent accidental pressing of the I/O switch and stoppage of the ventilation. Ensure that the device is stabilised. Call your customer service representative.
BUZZER FAULT3 RESTART/SRVC	Internal technical problem that prevents the battery from correctly charging.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
BUZZER FAULT4 RESTART/SRVC	Internal technical problem that prevents the battery warning buzzer from sounding POWER SUPPLY LOSS alarm.	Connect the ventilator to AC power and switch on the device using the on/off at the rear of the ventilator (I/O). Leave to charge for at least 15 minutes. If persists restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
BUZZER LOW BATTERY	Buzzer battery is too low to sound POWER SUPPLY LOSS alarm.	Connect the ventilator to AC power and switch on the device using the on/off at the rear of the ventilator (I/O). Leave to charge for at least 15 minutes.
CALIBRATE FIO2	An FiO <sub>2</sub> sensor is detected and has not been calibrated.	Calibrate FiO <sub>2</sub> sensor.
CALIBRATION FAIL	Too large a difference between a calibration point and its tolerance range.	Restart calibration. There may be a leak in the circuit. Ensure an approved circuit is in use (refer to circuit documentation).
	Incorrect circuit type selected in the Preferences menu.	Verify the circuit selection in the Preferences matches the circuit in use.
	Exhalation block defective or not properly aligned.	Reset alarm message and ensure all connections are secure, verify circuit integrity, and verify the exhalation block is properly seated.
	Defective exhalation flow sensor.	Have a qualified technician replace the defective component(s) and call your customer service representative.
CHECK BATTERY CHARGE	Battery charging impossible.	Do not disconnect the ventilator from the AC power supply. Ensure that the power cable is installed according to the instructions in chapter 6, "Installation and Assembly", so that the power cable cannot be involuntarily disconnected. In the event the internal battery capacity is low, use an alternate device to ventilate the patient. Call your customer service representative.

**Table 5-2.** Alarms and Corrective Actions (Continued)

Alarm Message or Symptom	Possible Reason(s) For The Alarm Event	Corrective Action(s)
CHECK EXH VALVE	Obstruction or abnormal damage of the exhalation valve.	Clean or replace the exhalation valve and/or its control tube.
	Excessive moisture in the exhalation block.	Remove moisture from exhalation block and valve. Verify exhalation valve is seated properly. Reduce temperature of the humidifier.
	Defective connection or defective exhalation valve tubing.	Reconnect the valve or replace the exhalation valve and/or the exhalation valve pilot pressure tube.
	Defective inspiratory flow sensor.	Have a qualified technician replace the defective component(s) and call your customer service representative.
CHECK EXH VALVE PRESSURE	The exhalation valve may not be detected by the ventilator when ventilation is started. Or the exhalation valve may be falsely detected when ventilation is started.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
CHECK FIO <sub>2</sub> SENSOR	FiO <sub>2</sub> measured is less than 18%.	Check that FIO <sub>2</sub> sensor is properly connected or Recalibrate FIO <sub>2</sub> sensor or Replace FIO <sub>2</sub> sensor.
CHECK PROXIMAL LINE1*  *IF PERSISTS RESTART/SRVC	No connection of the proximal pressure tube when ventilation starts.	Reconnect the proximal pressure line.
	Proximal pressure line disconnected or obstructed.	Reconnect the connection line or replace it if obstructed. Check for moisture or occlusion of the proximal line. Reduce humidifier temperature. Switch to a heated wire circuit.
	Defective proximal pressure sensor or internal leak of the machine.	Restart ventilator to see if alarm clears. If not, have a qualified technician replace the defective component(s) and call your customer service representative.
CHECK REMOTE ALARM	Nurse Call or remote alarm system is disconnected.	Connect the Nurse Call or remote alarm cable to the ventilator.
	Relay control voltage problem.	Carefully monitor the patient to detect possible alarm triggering and call for the maintenance technician.
CHECK SETTINGS	Loss of memorised parameters.	Check and adjust the prescribed parameters, if necessary.
	Software versions have changed.	Check and adjust the prescribed parameters, if necessary.
CONNECT VALVE OR CHANGE PRESS	The ventilation settings are not compatible with the type of patient circuit used. No exhalation valve connected with PEEP set to less than 4 mbar or PIP set to more than 30 mbar when relative pressure is set to OFF.	Connect exhalation valve Decrease PIP to less than 30 mbar in absolute pressure. Increase PEEP to more than 3 mbar. <b>Note:</b> Always consult the clinician before changing PEEP, FIO <sub>2</sub> , pressure, volume or Rate settings.




**Table 5-2.** Alarms and Corrective Actions (Continued)

Alarm Message or Symptom	Possible Reason(s) For The Alarm Event	Corrective Action(s)
CONTROLLED CYCLES	The ventilator is delivering apnea ventilation at set back up rate.	Check that the patient circuit is correctly attached and the patient is correctly ventilated.
COOLING FAN RESTART/SRVC	Operating speed of the cooling fan not properly adjusted for the internal ambient temperature of the device.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DC POWER DISCONNECTION	12 – 30 VDC power supply cut off when there is no AC ("mains") power supply.	Cancel the alarm then check the supply wiring and/or the effective availability of voltage on the external source.
	Ventilator's current-limiting fuse blown.	Replace the ventilator and call your customer service representative.
DEVICE FAULT3 IF PERSISTS RESTART/SRVC	24 V supply failure.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT5 IF PERSISTS RESTART/SRVC	Internal problem in the electrical power supply.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT7 IF PERSISTS RESTART/SRVC	Internal technical problem.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT9 IF PERSISTS RESTART/SRVC	POST RAM Error. RAM Read/Write does not match memory setting.	If patient has been disconnected, reconnect patient to reset the fault. If persists restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT10 IF PERSISTS RESTART/SRVC	POST FLASH Checksum Error. Startup FLASH computed checksum does not match memory setting.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT11 IF PERSISTS RESTART/SRVC	POST EEPROM Error. Startup EEPROM does not match memory setting.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT12 IF PERSISTS RESTART/SRVC	POST Reference Voltage Error. 5V or 10V reference voltage error.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT13 IF PERSISTS RESTART/SRVC	Incorrect software version detected.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
EMPTY BATTERY	Internal battery capacity is less than 10 min. (or 3%) —battery operation overextended.	Reconnect the device to an AC power outlet, connect it to an external DC power source, or replace the battery. Reminder: the internal battery can be charged only when the ventilator connected to an AC power supply.

**Table 5-2.** Alarms and Corrective Actions (Continued)

Alarm Message or Symptom	Possible Reason(s) For The Alarm Event	Corrective Action(s)
E SENS FAULT OR CIRC LEAK	Leak in the patient circuit, leak in patient artificial airway or vented mask interface.	<b>Note:</b> Always consult the clinician before changing PEEP, FIO <sub>2</sub> , pressure, volume or Rate settings. Check and properly connect the patient circuit connections. Minimise the leak. Ensure O <sub>2</sub> connector is removed. Reduce inspiratory time. Increase E-Sensitivity setting. Check tracheotomy cuff. Refit mask. Use non-vented mask.
	E sensitivity setting not properly adjusted	Check E Sensitivity setting <b>Note:</b> Always consult the clinician before changing PEEP, FIO <sub>2</sub> , pressure, volume or Rate settings.
EXH VALVE LEAKAGE	Large leakage detected on the patient circuit return limb during the inspiratory phase.	Replace the exhalation valve and/or its control tube.
	Contaminated or defective exhalation flow sensor.	Restart ventilator to see if alarm clears. If not, have a qualified technician replace the defective component(s) and call your customer service representative.
FIO <sub>2</sub> SENSOR MISSING	There is no FIO <sub>2</sub> sensor and FIO <sub>2</sub> alarms are active.	If oxygen is to be delivered to the patient, connect FIO <sub>2</sub> sensor. If no oxygen is to be delivered to the patient, deactivate FIO <sub>2</sub> alarms.
HIGH FIO <sub>2</sub>	The level of oxygen being delivered to the patient is higher than the Max FIO <sub>2</sub> limit set.	Check the level of oxygen corresponds to the patient's prescription or Increase the FIO <sub>2</sub> alarm threshold. <b>Note:</b> Always consult the clinician before changing PEEP, FIO <sub>2</sub> , pressure, volume or Rate settings.


**Table 5-2.** Alarms and Corrective Actions (Continued)

Alarm Message or Symptom	Possible Reason(s) For The Alarm Event	Corrective Action(s)
HIGH INT TEMP COOL VENT	Internal ambient temperature of the device out of the tolerance ranges.	<p><b>Note:</b> Ensure that you are operating the ventilator within the proper temperature range (refer to <a href="#">Appendix B, “Specifications”</a>).</p> <p>Put the device in a warmer environment (if the ambient temperature is too low) or in a cooler environment (if the ambient temperature is too high). For example, ensure the ventilator is not in direct sunlight or next to an air conditioning vent.</p> <p> <b>WARNING</b></p> <p>In case of operation in a high ambient temperature, handle the ventilator with care; some portions of the device may have high surface temperatures.</p> <p> <b>WARNING</b></p> <p>In the case of high ambient temperatures, it may take a significant period of time to cool the internal temperature of the ventilator to the proper operating range. To avoid injury to the patient, ensure that the air inspired by the patient does not exceed 41 °C (106 °F). If in doubt, replace the ventilator.</p>
	Defective internal temperature probe or any other technical anomaly.	Replace the ventilator and call your customer service representative.
HIGH/LOW BATTERY TEMP*  *IF PERSISTS RESTART/SRVC	Battery temperature out of the tolerance ranges.  Defective internal temperature probe or any other technical anomaly inside the battery.	<p><b>CAUTION:</b> Ensure that ventilator is being used according to the operating instructions found in <a href="#">Appendix B, “Specifications”</a>.</p> <p>If the ambient temperature is too low, place the device in a warmer environment.</p> <p>If the ambient temperature is too high, place the ventilator in a cooler environment.</p> <p>For example, ensure the ventilator is not in direct sunlight or next to an air conditioning vent. The temperature fault alarm does not interfere with the operation of the ventilator.</p> <p> <b>WARNING</b></p> <p>In case of operation in a high ambient temperature, handle the ventilator with care; some portions of the device may have high surface temperatures.</p> <p>Restart ventilator to see if alarm clears. If the alarm message persists, please contact technical services.</p> <p><b>CAUTION:</b> Do not attempt to charge a defective battery; such a battery cannot be charged.</p>


**Table 5-2.** Alarms and Corrective Actions (Continued)

Alarm Message or Symptom	Possible Reason(s) For The Alarm Event	Corrective Action(s)
HIGH LEAKAGE	The LEAK estimated by the ventilator exceeds the Max LEAK alarm threshold.	Readjust mask to reduce leakage or Increase the alarm settings.
HIGH VTE	Adjustment of the Max VTE level too low.	<b>Note:</b> Always consult the clinician before changing PEEP, FIO <sub>2</sub> , pressure, volume or Rate settings. Modify the Max VTE level.
	Inappropriate patient circuit.	Replace the patient circuit. Ensure there is not excessive airflow near the exhalation block (such as a fan).
	Exhalation flow sensor not calibrated properly.	Calibrate the exhalation flow sensor (refer to section 10.1, “Calibrating the Exhalation Flow Sensor,” on page 10-1).
	Defective exhalation flow sensor.	Replace the exhalation block and calibrate the exhalation flow sensor (see section 10.1, “Calibrating the Exhalation Flow Sensor,” on page 10-1). Call your customer service representative.
HIGH VTI	Adjustment of the Max VTI level too low (for PSV, CPAP, P A/C, P SIMV and V SIMV modes).	<b>Note:</b> Always consult the clinician before changing PEEP, FIO <sub>2</sub> , pressure, volume or Rate settings. Modify the Max VTI level.
	Adjustment of the pressure level too high for the volume required (for PSV, CPAP, P A/C, P SIMV and V SIMV modes).	<b>Note:</b> Always consult the clinician before changing PEEP, FIO <sub>2</sub> , pressure, volume or Rate settings. Modify the pressure level.
	A leak in the patient circuit causing increased bias flow.	Check and properly connect the patient circuit.
	Inappropriate patient circuit.	Replace the patient circuit.
	Defective flow sensor or internal leak in the machine.	Have a qualified technician replace the defective component(s) and call your customer service representative.
HIGH PRESSURE	Adjustment of Max PIP too low (only for V A/C and V SIMV modes).	<b>Note:</b> Always consult the clinician before changing PEEP, FIO <sub>2</sub> , pressure, volume or Rate settings. Increase the Max PIP threshold.
	Airway obstruction.	Check patient’s trachea and clear the obstruction. If the filter is obstructed, replace the filter.
	Proximal pressure tube or patient circuit obstructed.	Clean the proximal pressure tube or the patient circuit or replace them.
	Coughing or other high-flow exhalation efforts.	Treat patient’s cough. Silence the alarm, if necessary.
	Patient inspiratory resistance or compliance changes.	Have physician determine if ventilator settings are appropriate for the patient.
	Defective internal circuits of the machine or pressure sensor.	Replace the ventilator and call your customer service representative.

**Table 5-2.** Alarms and Corrective Actions (Continued)

Alarm Message or Symptom	Possible Reason(s) For The Alarm Event	Corrective Action(s)
HIGH RATE	Adjustment of the Max Rtot level too low.	Re-adjust Max Rtot.
	Adjustment of the I Sens level too low.	Adjust I Sens according to the patient.
	Patient hyperventilating.	Silence the alarm and call for a medical team if the symptoms persist. Check for auto-cycling and adjust inspiratory sensitivity, manage leaks or drain condensation from patient circuit.
	Defective inspiratory flow sensor.	Have a qualified technician replace the defective component(s) and call your customer service representative.
INSP FLOW RESTART/SRVC	Inspiratory flow is constant (+/- 1 lpm) with normal turbine temperature and speed conditions.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
INTENTIONAL VENT STOP	The user / caregiver has stopped ventilation by holding down the <b>VENTILATION ON/OFF</b>  key for three (3) seconds. by and ventilation is in stand-by.	Check that the ventilation was switched off on purpose. This alarm can be deactivated. Refer to chapter 7.3.1 , “Preferences Menu”.
KEYPAD FAULT RESTART/SRVC	Pressing a key for more than 45 seconds.	Press and release keys in the normal, prescribed manner. Do not press keys for 45 seconds or more.
	A key on the keyboard is stuck.	If unsuccessful in releasing the stuck key(s), restart ventilator to see if alarm clears. If not, replace the device and call your customer service representative if the situation persists.
LOW BATTERY	Internal battery capacity is less than 30 min. (or 8%)—battery operation overextended.	Immediately connect the ventilator to an AC power outlet, or connect it to an external DC power source. <u>Reminder:</u> the internal battery can be charged only when the ventilator is connected to an AC power supply.
LOW FIO2	The level of oxygen being delivered to the patient is below the Min FIO2 limit set.	<b>Note:</b> Always consult the clinician before changing PEEP, FIO <sub>2</sub> , pressure, volume or Rate settings. Check the level of oxygen corresponds to the patient’s prescription or Decrease the FIO <sub>2</sub> alarm threshold.

**Table 5-2.** Alarms and Corrective Actions (Continued)

Alarm Message or Symptom	Possible Reason(s) For The Alarm Event	Corrective Action(s)
LOW VTE	Patient circuit obstructed.	Clean, unblock, and/or properly connect the patient circuit.
	Leak in the patient circuit.	Check and properly connect the patient circuit connections. May be caused by increased resistance across exhalation filter (such as excessive moisture).
	Exhalation block missing or disconnected.	Restore or connect the exhalation block (refer to section 6.7, “Exhalation Block,” on page 6-12). If the exhalation block has been removed or replaced, calibrate the exhalation flow sensor (see section 10.1, “Calibrating the Exhalation Flow Sensor,” on page 10-1). Call your customer service representative.
	Adjustment of a Min VTE threshold when the patient circuit is in a single-limb configuration.	Set the Min VTE alarm limit to OFF.  <b>WARNING</b> <b>If exhaled tidal volume monitoring is required, use the double-limb circuit.</b>
	Inappropriate patient circuit.	Replace the patient circuit with an appropriate one.
	Exhalation flow sensor not properly calibrated.	Calibrate the exhalation flow sensor (refer to section 10.1, “Calibrating the Exhalation Flow Sensor,” on page 10-1).
	Defective exhalation flow sensor.	Replace the defective component(s) and calibrate the exhalation flow sensor (see section 10.1, “Calibrating the Exhalation Flow Sensor,” on page 10-1). Call your customer service representative.
	Adjustment of the Min VTE level too high.	Modify the Min VTE level.
LOW VTI	Adjustment of the Min VTI level too high (for PSV, CPAP, P A/C, P SIMV and V SIMV modes)	Modify the Min VTI level.
	Adjustment of the pressure level not enough to reach the volume required (for PSV, CPAP, P A/C, P SIMV and V SIMV modes).	Modify the pressure level according to the physician's prescription.
	Patient circuit obstructed or disconnected.	Clean, unblock, and/or reconnect the patient circuit.
	Inappropriate patient circuit.	Replace the patient circuit.
	Defective flow sensor or internal leak in the machine.	Check patient, replace the device and call your technician or customer service representative.
NO PROXIMAL LINE2	The proximal pressure line is disconnected.	Connect proximal pressure line.

**Table 5-2.** Alarms and Corrective Actions (Continued)

Alarm Message or Symptom	Possible Reason(s) For The Alarm Event	Corrective Action(s)
PATIENT DISCONNECTION  *IF PERSISTS RESTART/SRVC	Adjustment of Min PIP too high.	Decrease the Min PIP threshold.
	Leak or loose connection in the patient circuit. Circuit disconnection from patient or ventilator.	Check the patient circuit connections to the ventilator; examine all connections for leakage and tightness. Replace the patient circuit if necessary.
	Inspiratory flow exceeds 130 LPM.	Check Min PIP alarm setting. Adjust Apnea alarm setting.
	Inappropriate patient circuit.	Replace the patient circuit.
	Defective internal circuits of the machine or pressure sensor.	Restart ventilator to see if alarm clears. If not, have a qualified technician replace the defective component(s) or call your customer service representative.
OCCLUSION CHECK CIRCUIT  *IF PERSISTS RESTART/SRVC	Patient circuit obstructed.	Clean, unblock, and/or properly connect the patient circuit.
OCCLUSION CHECK CIRCUIT	The built-in LEAK in the mask may be obstructed. The built-in leak for the mask is not sufficient for the settings.	Clean, unblock, and/or properly connect the vented mask or check that the built in leak is sufficient for the PEEP setting.
POWER FAULT RESTART/SRVC	Internal problem in the electrical power supply.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
POWER SUPPLY LOSS  (without message)	Electrical power supply cut off by the main switch when ventilation is in progress.	Press the <b>I/O</b> switch to restore electrical power to the ventilator and allow ventilation to continue. To stop ventilation, press the VENTILATION ON/OFF key for three seconds (refer to chapter 7, "Operating Procedures").
	The internal battery that supplies the ventilator is entirely discharged.	Immediately connect the ventilator to an AC power outlet or an external DC power source; otherwise, use an alternate device to ventilate the patient.
PRES SENS FLT1 RESTART/SERV	Defective internal pressure sensor.	Restart ventilator to see if alarm clears. If not, have a qualified technician replace the defective component(s) and call your customer service representative.
PROX SENS FLT2 RESTART/SRVC	Defective proximal pressure sensor or internal leak of the machine.	Restart ventilator to see if alarm clears. If not, have a qualified technician replace the defective component(s) and call your customer service representative.
REMOVE VALVE OR CHANGE PRES	The ventilation settings are not compatible with the type of patient circuit used.	Remove exhalation valve to start ventilation with less than 5 mbar of difference between PEEP and PIP or Increase the difference between PEEP and PIP to a minimum of 5 mbar.
REMOVE VALVE CPAP MODE	The ventilation settings are not compatible with the type of patient circuit used.	Remove exhalation valve to start CPAP ventilation.

**Table 5-2.** Alarms and Corrective Actions (Continued)

Alarm Message or Symptom	Possible Reason(s) For The Alarm Event	Corrective Action(s)
SOFTWARE VERSION ERROR	Incorrect software version detected.	Call your customer service representative.
TURB OVERHEAT RESTART/SRVC	Turbine overheated because of blockage during operation.	Ensure lateral and front openings are not obstructed. Check air inlet filter. Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
UNKNOWN BATTERY	Internal battery not recognised as a Puritan Bennett™ product battery.	Call your customer service representative.
VALVE MISSING CONNECT VALVE	The ventilation settings are not compatible with the type of patient circuit used.	Connect exhalation valve.
VTI NOT REACHED *IF PERSISTS RESTART/SERV	Defective inspiratory flow sensor or internal leak of the machine.	Restart ventilator to see if alarm clears. If not, replace the defective device(s) and have a skilled technician check them.
	I time is not long enough to deliver set VT.	Increase I time or decrease VT.

## 5.8.2 Additional Troubleshooting

Table 5-3 provides other possible ventilator problems, causes, and corrective actions.



### WARNING

**If the device is damaged, its external housing is not correctly closed, or it behaves in a way that is not described in this manual (excessive noise, heat emission, unusual odour, alarms not triggered during the start-up procedure), the oxygen and power supplies should be disconnected and use of the device stopped immediately.**

**If you cannot determine the cause of the problem, contact your equipment supplier. Do not use the ventilator until the problem has been corrected.**

### Note:

Buzzer and battery alarms may occur when the unit is first powered on after the internal battery has been completely drained. Connect to an AC power source and recycle power.

**Table 5-3.** Additional Troubleshooting and Corrective Actions

Conditions	Possible Causes	Corrective Actions
No access to the waveforms	Display waveform set to NO in Preferences menu.	Set Display waveform to YES in Preferences menu (refer to section 7.3, "Preferences Menu Parameters").
The screen backlight never switches off during ventilation	Backlight set to NO in Preferences menu.	Set Backlight to YES in Preferences menu (refer to section 7.3, "Preferences Menu Parameters").
Alarm sound level too low or too high	Adjustment of the alarm sound level is incompatible with the patient's environment.	Re-adjust sound level (refer to section 7.3, "Preferences Menu Parameters").

**Table 5-3.** Additional Troubleshooting and Corrective Actions (Continued)

Conditions	Possible Causes	Corrective Actions
Poor visibility of the displays	Contrast adjustment is incompatible with the luminosity of the environment.	Re-adjust contrast (refer to section 7.3, "Preferences Menu Parameters").
Unusual display on the screen	Problem with the display unit.	Adjust contrast or call your customer service representative if the problem persists. Ensure that the ventilator is not exposed to direct radiation from the sun.
The ventilator does not operate after pressing I/O switch	No external power source and the internal battery is completely discharged.	Connect the ventilator to the AC power source.
Light noise	Turbine noise.	Replace the ventilator and call your customer service representative.
Whistling noise or vibrations	Filter and/or turbine silencer deteriorated.	Replace the ventilator and call your customer service representative.
	Valve membranes damaged.	Replace the ventilator and call your customer service representative.
Excessive heat emitted	Obstruction of main or secondary air inlets of the casings.	Remove obstructions from all blocked ventilator air inlets and outlets.
Condensation inside the device	Liquid entered the device.	Replace the ventilator and call your customer service representative.





## 6 Installation and Assembly



### WARNING

Before operating the ventilator, read, understand, and strictly follow the information contained in Chapter 1, “Safety Information”.

A patient treated by mechanical ventilation is highly vulnerable to the risks of infection. Dirty or contaminated equipment is a potential source of infection. Clean the ventilator and its accessories regularly and systematically before and after each use and following any maintenance procedure to reduce the risks of infection. The use of a bacterial filter at the ventilator’s outlet—or both ports if a double-limb circuit is used—is highly recommended. Refer to chapter 9, “Cleaning”.

### 6.1 Installing the Ventilator

#### To install your Puritan Bennett™ 560 Ventilator :

- Choose an area where air can circulate freely; avoid proximity to loose fabrics such as curtains.
- Avoid direct exposure to sunlight.
- Set the ventilator on a flat and stable surface so that its feet are all in contact with the surface. The ventilator may operate in any position, provided that the air inlets are not obstructed and the device cannot fall and possibly cause damage and/or personal injury.



### WARNING

The operator should connect the ventilator to an AC power source whenever available, for safer operation.

To ensure correct and lasting operation of the ventilator, ensure that its air circulation holes (main inlet or cooling) are never obstructed. Place the device in an area where air can freely circulate around the ventilator and avoid installing it near floating fabrics, such as curtains.

Do not place the ventilator in a position where a child can reach it or in any position that might cause it to fall on the patient or someone else.

Ensure that the ventilator’s immediate surroundings allow for the proper operational connection of the device without folding, pinching, or damaging any of the required cables or tubes, and that the connection of the patient circuit to the patient provides for a secure, comfortable fit.

Do not operate the ventilator in direct sunlight, near heat sources, outdoors, or near installations where liquid may pose a risk without first providing adequate protection for the device.

If the ambient temperature where the device is operated is greater than 35 °C (95 °F), the flow supplied at the device outlet may exceed 41 °C (106 °F). This may lead to undesirable side effects for the patient. To avoid injury to the patient move the patient and the ventilator to a cooler location. For more information, contact Covidien.

To reduce the risk of a fire hazard, keep matches, lighted cigarettes, and all other sources of ignition (such as flammable anesthetics and/or heaters) away from the ventilator and oxygen hoses.

Never connect your ventilator to an electrical outlet controlled by a wall switch because the power may be inadvertently turned off.

Even if the "INTERNAL BATTERY" charging indicator is off, charging of the battery may sometimes be incomplete if the ambient temperature is above 40 °C (104 °F) because of the battery's internal heat safety device.

The use of any accessory other than those specified, with the exception of the power supplies or cables sold by Covidien, may lead to an increase in electromagnetic emissions or a decrease in the equipment protection against electromagnetic emissions. If the ventilator is used adjacent to such accessories or stacked with such devices, the ventilator's performance should be monitored to verify normal operation.

The Puritan Bennett™ 560 Ventilator requires special precautions for electromagnetic compatibility and should be installed and started according to the recommendations found in Appendix B, "Specifications". In particular, the use of nearby mobile and portable communications equipment using radio frequencies, such as mobile telephones or other systems exceeding the levels set in the IEC / EN 60601-1-2 standard, may affect its operation. Refer to section B.10, "Manufacturer's Declaration," on page B-9.

The ventilator must not use, nor be connected to, any anti-static or electrically conductive hoses, tubing, or conduits.

## 6.2 Connecting to External AC Power

Any of four power sources: AC power, 12 – 30 VDC power, Internal Battery power, or Auxiliary DC car adapter (cigarette lighter) can be used to power the ventilator. But when AC power is available, the ventilator will automatically select AC power as its operating power source.



### WARNING

The power supply to which the ventilator is connected (both AC and DC) must comply with all current and applicable standards and provide electrical power corresponding to the voltage characteristics inscribed on the rear of the ventilator to ensure correct operation.

Ensure that the AC power cable is in perfect condition and not compressed. The device should not be turned on if the AC power cable is damaged.

Connect the external electrical power source by first connecting the power cable to the ventilator and then to the external power source. Follow the reverse procedure to disconnect the device from electrical power sources.

Do not leave power cables lying on the ground where they may pose a hazard.

To prevent accidental disconnection of the AC power cable, use the power cable holder (Figure 6-1, item 1) that is inserted into the notch (Figure 6-1, item 2) of the battery cover: AC Power Cable Holder

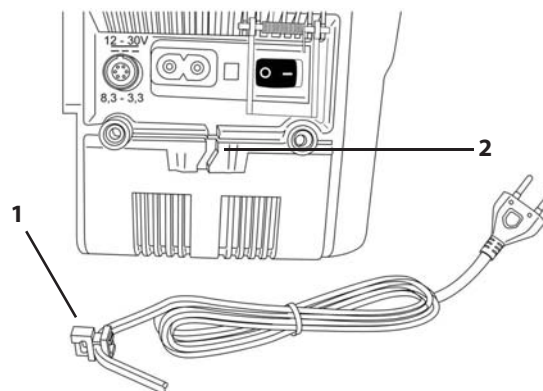
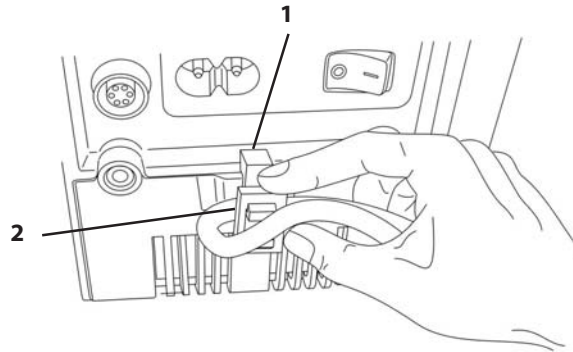


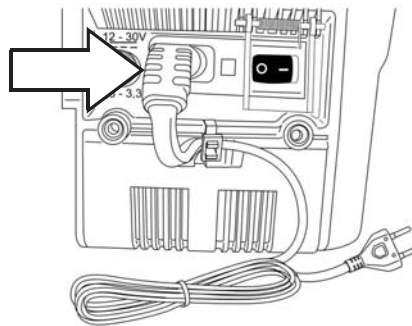
Figure 6-1. The Power Cable Holder



**To secure the AC power cable:**

1. Insert the power cable holder (Figure 6-2, item 1) into the notch of the battery cover.

**Figure 6-2.** Inserting the Power Cable Holder Into the Notch

2. Push the AC power cable into the power cable holder (Figure 6-2, item 2).
3. Connect the female end of the ventilator's AC power cable to the AC connector on the back of the ventilator.

**Figure 6-3.** Power Cable Connected to the Ventilator

4. Connect the male end of the AC power cable to the AC power outlet.
  - The **AC POWER**  indicator on the top left corner of the ventilator illuminates.
  - The indicator  flashes while the battery charges and then turns off when the battery is fully charged.

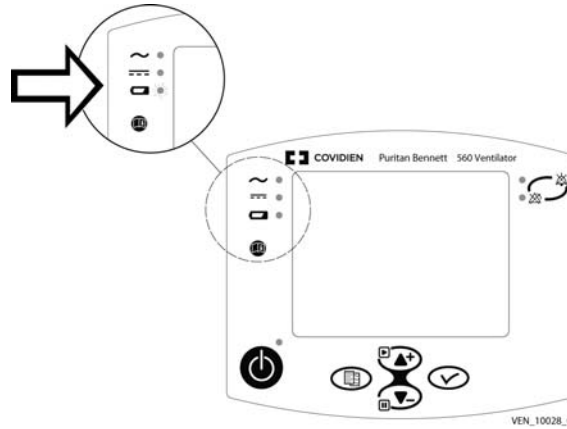
Refer to Figure 6-4 on page 6-4.

If the AC power cable becomes disconnected or the AC power source fails, an "AC POWER DISCONNECTION" alarm signals an automatic switch to the external DC power source (if the DC power cable is connected) or to the ventilator's internal battery.

One of three power indicators, located on the upper-left of the ventilator's front panel, illuminates to signal which of the three possible power sources are currently in use by the device (refer to Figure 6-4).

**Note:**

The only time the AC POWER and indicators are illuminated at the same time is when the ventilator is connected to an AC supply and the battery is charging (indicator is flashing).



**Figure 6-4.** Power Indicators

**To disconnect the AC power cable:**

1. Disconnect the AC power cable from the AC power outlet.
2. Disconnect the AC power cable from the ventilator's AC connector at the rear of the device.
3. Grasp the AC power cable at the level of the power cable holder and turn the cable counterclockwise while lifting it upwards and out of the holder.

## 6.3 Connecting to an External DC Power Source



**WARNING**

**Ensure that the ventilator's internal battery is fully charged before connecting the ventilator to an external DC power source. Powering the ventilator using an external 12– 30 VDC power source (via the DC power cable) does not enable charging of its internal battery.**

**When using a car auxiliary adapter (cigarette lighter) ensure the car has been started prior to plugging in the ventilator's DC adapter.**

**Note:**

An alternative means of ventilation should always be available, particularly when the patient is in transit or away from wall power.

While using the ventilator on external battery power it is vital that a qualified caregiver (capable of providing necessary corrective actions in the event of alarm conditions) is present.

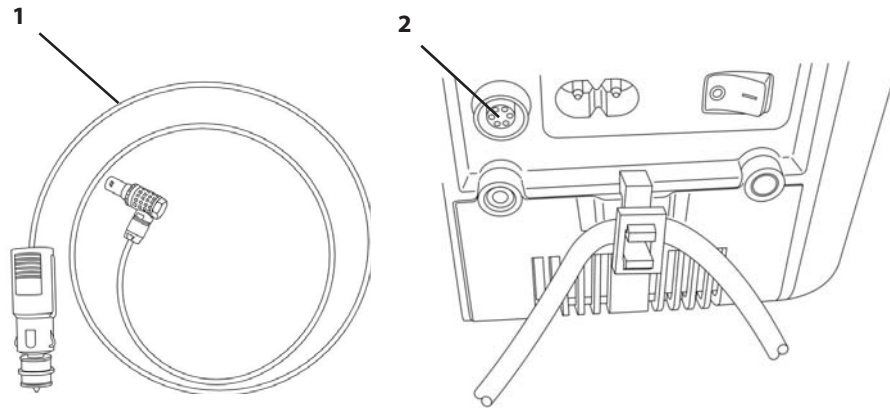
When AC power is not available use an external DC power prior to using internal battery power.

**To connect the ventilator to an external power source do the following:**

1. Ensure the car's engine is started prior to connecting the ventilator.
2. Firstly connect the DC power cable into the ventilator.
3. Then connect the DC power cable into the car auxiliary adapter.

**Note:**

Whenever AC power is unavailable, the ventilator can operate from a continuously powered external 12 – 30 VDC power source via a DC power cable (Figure 6-5, item 1) that connects to the ventilator's rear panel DC power input connector (Figure 6-5, item 2). The DC power cable is optional; refer to [Appendix H, "Parts and Accessories"](#), for more information. It is possible to use the DC auxiliary port (cigarette lighter) in a car as a power source as well.



**Figure 6-5.** Connecting the Ventilator to an External DC Power Source

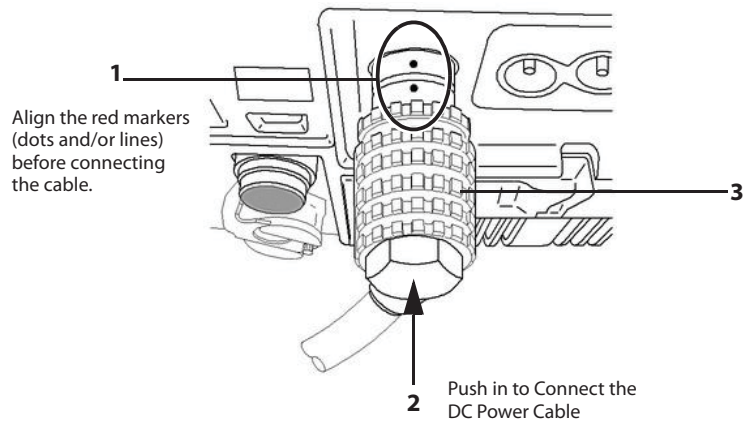
**WARNING**

Connect the external DC power source by first connecting the power cable to the ventilator and then to the external DC source. Follow the reverse procedure to disconnect the device from the external DC power source.




**To connect the DC power cable to the ventilator:**

1. Line up the red marker dot on the ventilator's DC power connector with the marker on the DC power cable (Figure 6-6, item 1).



**Figure 6-6.** Connecting the DC Power Cable to the Ventilator

2. Push the DC power cable onto the ventilator's DC power connector (Figure 6-6, item 2).
  - You will hear a locking “click”.
  - The **DC POWER**  indicator on the top left corner of the ventilator illuminates (see Figure 6-4).

To disconnect the DC power cable from the ventilator, slide the locking ring (Figure 6-6, item 3) back and pull the plug away from the ventilator's rear panel to disengage it.

An “DC POWER DISCONNECTION” alarm signals an automatic switch to the internal battery in case the external DC power source fails or becomes disconnected.

## 6.4 Patient Circuit



### WARNING

Before opening the packaging for the Patient Circuit, ensure that no damage is evident to the packaging or its contents. Do not use if evidence of damage exists.

For pediatric use, ensure that the patient circuit type fits, and, in all respects, is suitable for use with a child. Use a pediatric circuit for patients that weigh under 53 lb. (23 kg). See Table H-2, [List of Circuits](#) on page H-2 for a list of recommended patient circuits.

If exhaled tidal volume measurements are required to ensure correct patient ventilation a double limb patient circuit configuration must be used in order to detect leaks. In this case, both the minimum and maximum VTE alarm parameters must be properly set to warn in the event of patient suffocation.

The patient circuit should always be positioned to avoid hindering the patient's movements, to prevent accidental disconnection or leakage, and to minimise the risk of patient strangulation.

Ensure that the ventilator's immediate surroundings allow for the proper operational connection of the device without folding, pinching, or damaging any of the required cables or tubes, and that the connection of the patient circuit to the patient provides for a secure, comfortable fit.

The patient circuit is intended for single use by a single patient and should be changed according to the manufacturer's recommendations and according to the patient circuit lifetime. Refer to the instructions for use supplied by the manufacturer of the patient circuit (included with the ventilator) and chapter 6, ["Installation and Assembly"](#).

After assembling, cleaning, or reassembling the patient circuit, and on a daily basis, inspect the hoses and other components to ensure that there are no cracks or leaks and that all connections are secure.

To ensure proper performance of the ventilator, use a patient circuit recommended by Puritan Bennett in this manual; refer to chapter 6, ["Installation and Assembly"](#) and [Appendix H, "Parts and Accessories"](#). The total specified length of the patient circuit tubing as measured from the ventilator outlet to the ventilator inlet is 1.1 metres (3.6 feet) to 2.0 metres (6.6 feet). The tubing must conform to all applicable standards and must be fitted with Ø 22 mm terminals that also conform to all applicable standards. Ensure that both the length and the internal volume of the patient circuit are appropriate for the tidal volume: a corrugated tube of Ø 22 mm for adult patients, and a corrugated tube of Ø 15 mm for pediatric patients with a tidal volume lower than 200 ml.

Adding accessories to the ventilator breathing circuit, such as a humidifier and water trap(s), may result in a decrease in tidal volume delivered to the patient due to the added compressible volume of the accessory. Always assure that the patient is receiving the appropriate inspired volume when altering the breathing circuit configuration.

Users must always possess an additional breathing circuit and exhalation valve while using the Puritan Bennett™ 560 Ventilator .

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### 6.4.1 Choosing the Patient Circuit Type

Single limb circuits are used with breathing modes where spirometry measurements are not required, and double limb circuits are used with breathing modes where spirometry is required. Be sure to choose the appropriate circuit in the menu preferences; in particular, ensure that Pediatric Circuit Yes/No is set to YES when using a pediatric circuit (refer to Appendix H, ["Parts and Accessories"](#)).


For information regarding validated circuits, visit the SolvIT<sup>SM</sup> Center Knowledge Base by clicking the link at <http://www.puritanbennett.com> or contact your customer representative.

### 6.4.2 Installing the Patient Circuit

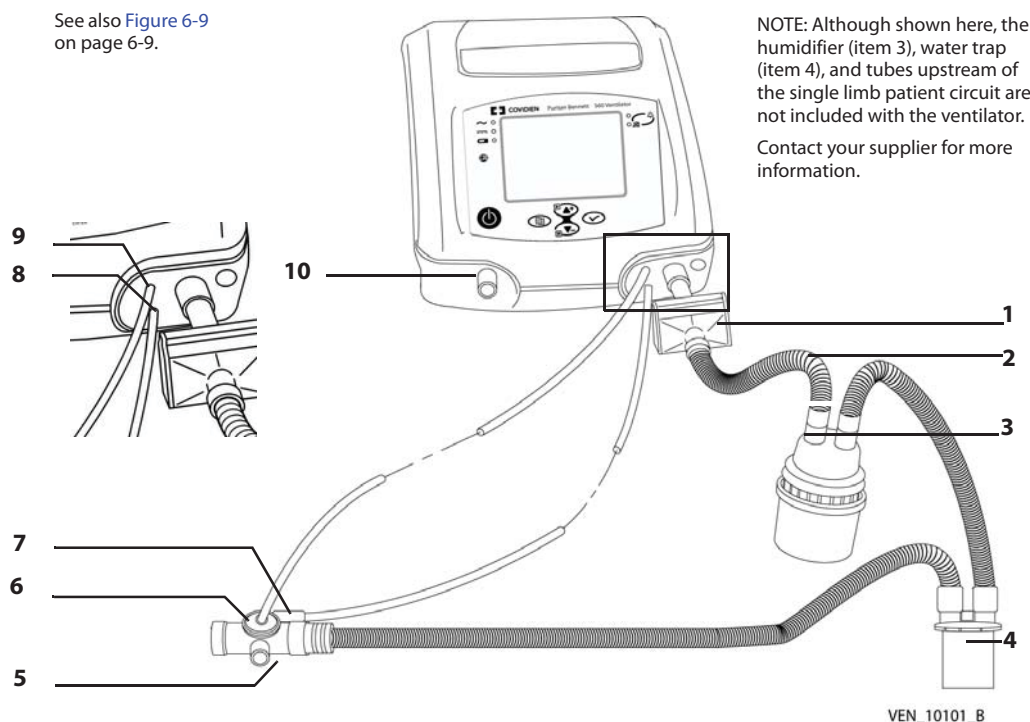
The patient circuit is mounted depending on the setup of the circuit used and the accessories used.

The following procedures describe the installation of the patient circuit with a humidifier. To add other accessories, refer to the installation instructions for the specific accessories used.

**To connect a single limb circuit with an exhalation valve: (refer to Figure 6-7)**


1. Inspect the components of the patient circuit for any signs of damage, such as cracks (which might cause leakage). Do not use damaged components to assemble the patient circuit.
2. Install the bacteria filter (item 1) on the TO PATIENT  outlet port, as shown.
3. Attach one end of the short circuit tubing (item 2) to the bacteria filter (item 1).
4. Attach the other end of the circuit tubing (item 2) to the inlet port of the humidifier (item 3).
5. Place a water trap (item 4) between the outlet port of the humidifier and the inlet of the exhalation valve (item 5).
6. Ensure the exhalation valve (item 5) is placed as close as possible to the patient.
7. Connect one end of the proximal pressure tubing (item 7) to the proximal pressure port on the exhalation valve (item 5) and the other end onto the ventilator patient pressure port (item 8).
8. Connect one end of the exhalation valve tubing (item 6) to the exhalation valve port on the exhalation valve (item 5) and the other end onto the ventilator exhalation valve port (item 9).
9. To protect the exhalation port (as it will not be used in this configuration), place the cap (if provided with the breathing circuit) over the exhalation port opening (item 10).


See also [Figure 6-9](#)  
on page 6-9.



**Figure 6-7.** Single Limb Patient Circuit With Exhalation Valve

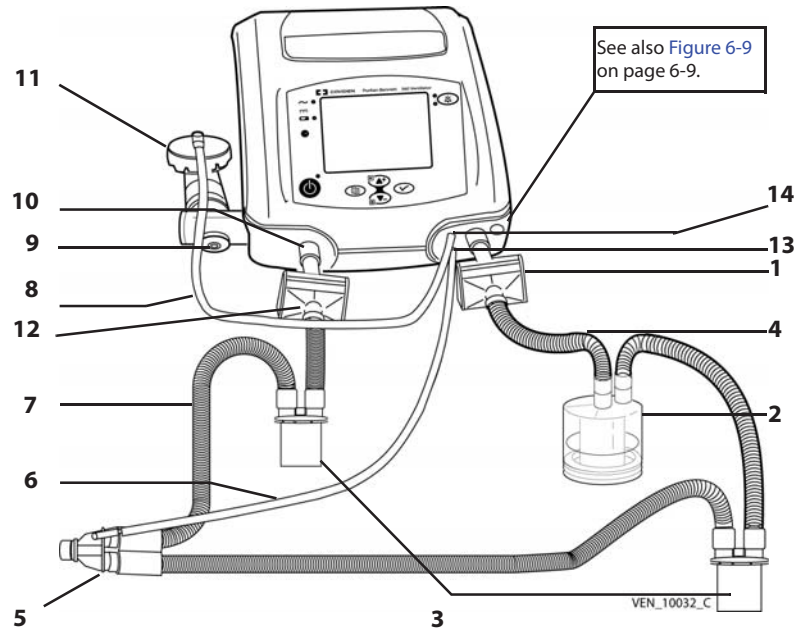
**To connect a double limb circuit: (refer to Figure 6-8)**

1. Inspect the components of the patient circuit for any signs of damage, such as cracks (which might cause leakage). Do not use damaged components to assemble the patient circuit.
2. Install the bacteria filter (item 1) on the TO PATIENT  outlet port.

3. Attach one end of the short circuit tubing (item 4) to the filter (item 1).
4. Attach the other end of the circuit tubing to the inlet port of the humidifier (item 2).
5. Place a water trap (item 3) between the outlet port of the humidifier and the patient wye (item 5) on the double limb circuit.
6. Place a second water trap (item 3) between the patient wye (item 5) and the inlet port of exhalation bacteria filter (item 12).
7. Connect the exhalation bacterial filter (item 12) between the FROM PATIENT  inlet port (item 10) and the exhalation limb of the patient circuit.
8. Connect one end of the small proximal pressure tubing (item 6) to the double limb patient wye circuit connection (item 5) and the other end on the ventilator patient pressure port (item 13).
9. Place the exhalation valve assembly (item 9) on the exhaust port.
10. Connect the tubing (item 8) from the exhalation valve assembly to the exhalation valve port (item 13) of the ventilator.

**Note:**

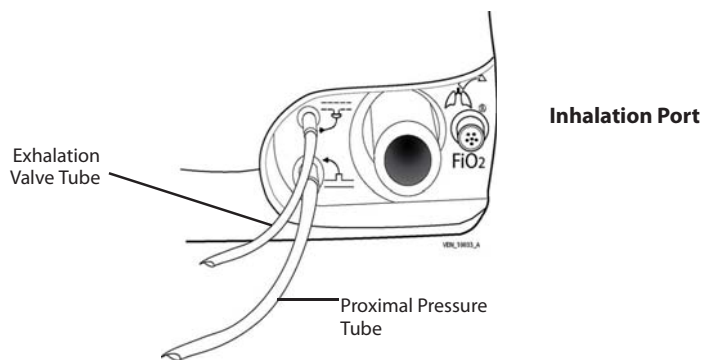
When shipped, the proximal pressure tube may already be connected to the patient wye. If so, simply verify that the connection is secure and the tube shows no signs of damage, kinks, or obstructions.



**Figure 6-8.** Double Limb Patient Circuit

**Note:**

Although shown here, the humidifier (item 2), water traps (item 3), and their connecting tubes are not included with the patient circuit or ventilator. Contact your supplier for more information.




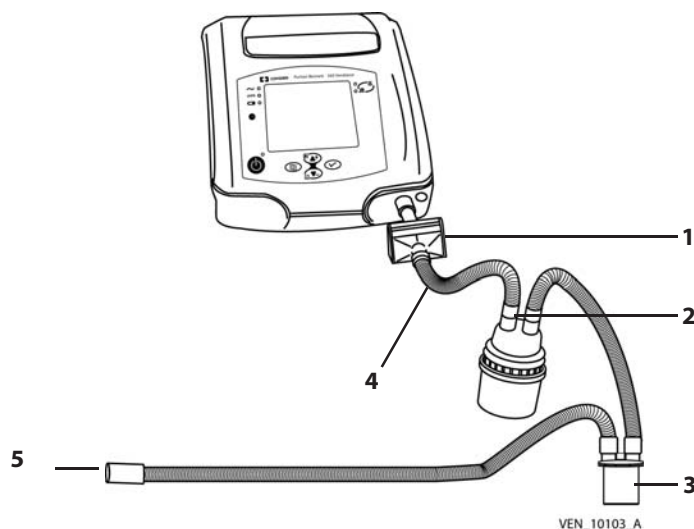
**Figure 6-9.** Close-up of Exhalation Valve Tube and Proximal Pressure Tube

Figure 6-9 shows details of the connections of the proximal pressure tube (Figure 6-8, item 6) and the exhalation valve tube (Figure 6-8, item 8).

**To connect a single limb circuit without an exhalation valve (NIV only):**

refer to Figure 6-10.

1. Inspect the components of the patient circuit for any signs of damage, such as cracks (which might cause leakage). Do not use damaged components to assemble the patient circuit.
2. Install the bacteria filter (item 1) on the TO PATIENT  outlet port, as shown.
3. Attach one end of the short circuit tubing (item 4) to the filter (item 1)
4. Attach the other end of the circuit tubing (item 4) to the inlet port of the humidifier (item 2).
5. Place a water trap (item 3) between the outlet port of the humidifier and the patient end.
6. Place a vented (NIV) interface to the end of the patient circuit. (item 5)



**Figure 6-10.** Single limb Patient Circuit Without Exhalation Valve

For both types of circuits, shown previously, you should connect the end of the proximal pressure tube as close as possible to the patient (at the mask or cannula entry, if possible) so that the ventilator can account for all load losses due to the circuit and its potential accessories. If this is not possible, it is

best to modify the PATIENT DISCONNECTION triggering threshold by doing one of the following: set a Max VTi alarm limit for pressure modes or a Min VTE alarm limit for all ventilation modes if using a dual limb circuit.

As a reminder: Ensure that the length and the internal volume of the patient circuit are compatible with the tidal volume: ringed tube Ø 22 mm for adults and ringed tube Ø 15 mm for pediatric patients with tidal volumes lower than 200 ml. Use, if necessary, a 22F-15M link on the outlet and a 15M-22M link on the exhalation block for a double limb circuit.



**WARNING**

**When using non-invasive ventilation (NIV), without an exhalation valve, use a vented nose or face mask or a non vented combined with a leak accessory. When using non-invasive ventilation (NIV), with an exhalation valve, use a non vented mask.**

**The level of inspiratory resistance of the circuit and accessories (bacteria filter, humidifier, and so on) must be as low as possible. Settings—particularly the PATIENT DISCONNECTION alarm, High inspired volume (High VTi), and Low inspired volume (Low VTi) settings—must be periodically adjusted according to changes in the patient circuit resistance—especially when filters are replaced.**

**Resistance of the exhalation valve and accessories (water traps, filters, HMEs etc) must be as low as possible.**

**The exhalation valve must allow rapid discharge of the circuit pressure. Ensure that the exhalation valve is always clean and its evacuation aperture (exhaust port) is never obstructed.**

**Do not start ventilation until you ensure that the device is suitably assembled, that the air inlet filter is properly installed and is not obstructed, and that there is proper clearance all around the unit. Also ensure that the patient circuit is suitably connected to both the ventilator and the patient and that the patient circuit, including all hoses, is not damaged or obstructed.**

**Adding accessories to the ventilator breathing circuit, such as a humidifier and water trap(s), may result in a decrease in tidal volume delivered to the patient due to the added compressible volume of the accessory. Always assure that the patient is receiving the appropriate inspired volume when altering the breathing circuit configuration.**

---

## 6.5 Filters



**WARNING**

**Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. If necessary, replace the filter before the recommended replacement period is over (see chapter 10, “[Routine Maintenance](#)”). This is particularly important when the ventilator is installed on a wheelchair, because environmental conditions may cause the filter to become dirty more rapidly.**

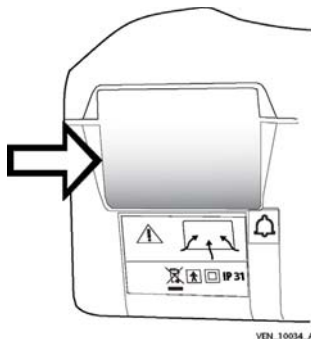
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The ventilator features two filter types:

- air inlet filter
- bacteria filter

### Air Inlet Filter

Consisting of foam and fine particle filter media and located at the rear of the ventilator, this filters the air as it enters the ventilator.



**Figure 6-11.** Air Inlet Filter







#### WARNING

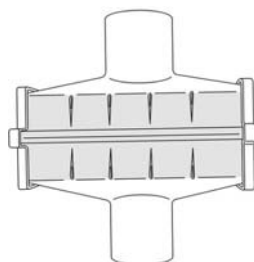
**The air inlet filter is not reusable; do not attempt to wash, clean, or reuse it.**

**Failing to replace a dirty air inlet filter, or operating the ventilator without a filter, may cause serious damage to the ventilator.**

### Bacteria Filter

It is highly recommended that you install a bacteria filter (see [Figure 6-12](#)) on both single and double limb circuits. In a double limb configuration, two bacteria filters are used: one at the TO PATIENT  port, and the other at the FROM PATIENT  port.

- Connected to the TO PATIENT  port:  
This filter protects the ventilator from contamination by the patient (primarily, rebreathed gas). Refer to [Figure 6-8](#), item 1.
- Connected to the FROM PATIENT  port:  
This filter protects the internal exhalation flow sensor from the gases exhaled by the patient. Refer to [Figure 6-8](#), item 10.



**Figure 6-12.** Bacteria Filter

Refer to the manufacturer's instructions for more information about the use and maintenance of the bacteria filter(s).

## 6.6 Humidifier

The humidifier (Figure 6-13) adds moisture (water vapour) and warms the gas in the patient circuit. It is inserted into the patient circuit between the main outlet and the patient (refer to Figure 6-7 and Figure 6-8).



### WARNING

**During invasive ventilation (when an artificial airway bypasses the patient's upper respiratory system), the patient's upper respiratory system cannot humidify the incoming gas. For this reason, the use of a humidifier, to minimise drying of the patient's airways and subsequent irritation and discomfort, must be used.**

**Always position a humidification device so that it is lower than both the ventilator and the patient. Use water traps, if necessary, to limit water in the patient circuit and periodically empty these water traps.**

**If a heated humidifier is used, you should always monitor the temperature of the gas delivered to the patient. Gas delivered from the ventilator that becomes too hot may burn the patient's airway.**

**Adding accessories to the ventilator breathing circuit, such as a humidifier and water trap(s), may result in a decrease in tidal volume delivered to the patient due to the added compressible volume of the accessory. Always assure that the patient is receiving the appropriate inspired volume when altering the breathing circuit configuration.**

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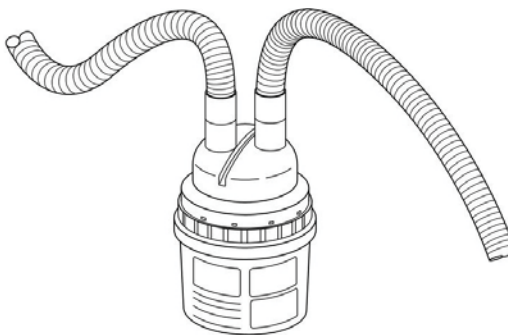


Figure 6-13. Humidifier

When a humidification device is used, any condensation that forms in the patient circuit is collected in the water trap. If you notice any moisture in the patient circuit, you need to replace the wet circuit components with dry ones.

Refer to the humidification device's instruction for information on operating, cleaning, and sterilising the humidifier.

## 6.7 Exhalation Block



### WARNING

**The exhalation block is intended for single use by a single patient. It may periodically be cleaned, but it cannot be disinfected or sterilised. To maintain good measurement quality when used continuously, clean the exhalation block periodically (refer to section 9.3, "Cleaning the Exhalation Block," on page 9-2). The exhalation block should be changed every 4 months and cannot be reused with any other patient.**

**Ensure that the exhalation block is completely dried after cleaning and prior to use.**

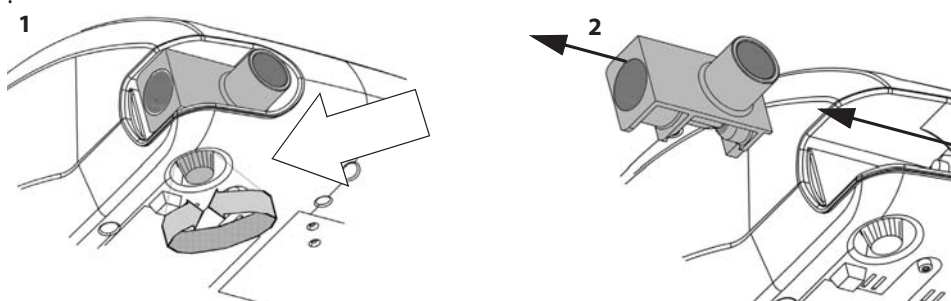
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The exhalation block can be easily removed from the device for inspection, cleaning, and replacement. No special tools are required. It is held in place by a single captive screw located on the bottom of the device.

#### To remove the exhalation block:

Refer to [Figure 6-14](#) if required:

1. Ensure the ventilator is turned off.
2. Loosen the captive screw located on the bottom of the ventilator that secures the exhalation block ([Figure 6-14](#), item 1). Grasp the exhalation port and slide the exhalation block to the left to remove it from its slot ([Figure 6-14](#), item 2)



**Figure 6-14.** Removing the Exhalation Block

After removal, the exhalation block can either be cleaned or, if required, replaced with a new one. For information on cleaning, refer to section [9.3](#), 'Cleaning the Exhalation Block'.

#### To install either a cleaned or a new exhalation block:

Refer to [Figure 6-14](#) if required:

1. Slide the exhalation block into its slot.
2. Tighten the captive screw to secure the exhalation block in place.
3. Recalibrate the exhalation flow sensor. Refer to section [10.1](#), "Calibrating the Exhalation Flow Sensor," on page [10-1](#).



#### WARNING

When an exhalation block is set up, each time it is removed, or after installing a new exhalation block on the machine, it is essential that the exhalation flow sensor be recalibrated before the exhalation block is used. Refer to section [10.1](#), "Calibrating the Exhalation Flow Sensor," on page [10-1](#).

## 6.8 Oxygen



#### WARNING

The ventilator must not be used with flammable anesthetic substances.

## 6.8.1 Administering Oxygen



### WARNING

Oxygen therapy for patients with respiratory failure is a common and effective medical prescription. However, be aware that inappropriate oxygen use may potentially lead to serious complications, including, but not limited to, patient injury.

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Oxygen administered to the patient is introduced from an external source into the machine through the oxygen connector at the rear of the ventilator. It is then integrated into the total volume of delivered gas. Remove the oxygen inlet connector from the back of the ventilator when external oxygen is not in use.

The specific oxygen flow to the patient depends on the physiological characteristics of the patient and the ventilator settings.

The oxygen flow setting should be adjusted for *each* patient and established in relation to a *calibrated* oxygen monitor measurement. Since the factors that affect administered oxygen flow may change over time, you must ensure that these settings always correspond to the *current* oxygen therapy objectives specified by the physician. (Refer to chapter 3.7, “FiO<sub>2</sub> For Various Oxygen and Ventilator Settings”).



### WARNING

To avoid injury to the patient and/or possible damage to the ventilator: before using the ventilator, use a flow meter (flow regulator) to regulate the oxygen supply to specifications before connecting the ventilator to the oxygen supply.

Ensure that the oxygen supply pressure to the machine never exceeds 7 psi (50 kPa) or a flow of 15 lpm. Refer to [Table B-8](#) on page B-3 for volume and sensitivity tolerances.

- The Puritan Bennett™ 560 Ventilator can be used with an optional oxygen analyser with minimum and maximum concentration alarms. Always measure the delivered oxygen with a calibrated oxygen analyser (FiO<sub>2</sub> kit) that features a minimum and maximum concentration alarm in order to ensure that the prescribed oxygen concentration is delivered to the patient.
- 

## 6.8.2 Connecting the Oxygen Supply



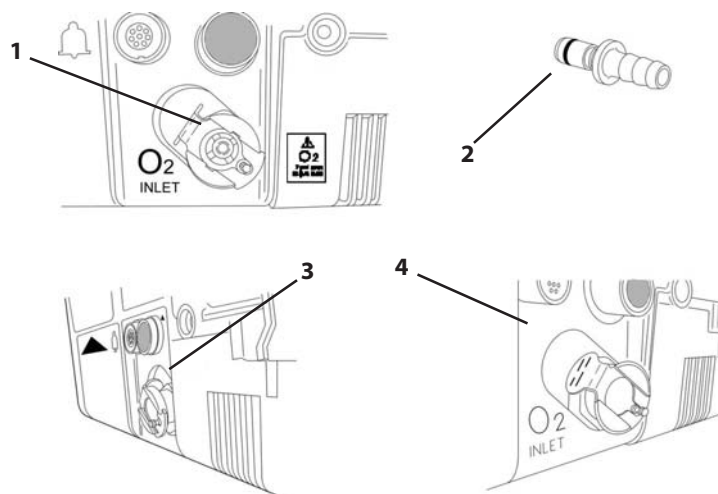
### WARNING

Ensure that the only gas supplied to the ventilator through the dedicated oxygen supply connector is medical-grade oxygen.

The hose connecting the ventilator to the oxygen source must be designed exclusively for use with medical-grade oxygen. Under no circumstances should the oxygen hose be modified by the user. In addition, the hose must be installed without the use of lubricants.

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A connector ([Figure 6-15](#), item 1) for an external low pressure oxygen source is available at the rear of the ventilator. It is essential that you also use the special coupler (item 2) supplied with the ventilator to attach the external low pressure oxygen source to the connector. The connector is also fitted with a non-return airtight valve system. The non-return airtight valve system includes a stud (item 3) and a locking tab (item 4).



**Figure 6-15.** Rear Panel Oxygen Connector



**WARNING**

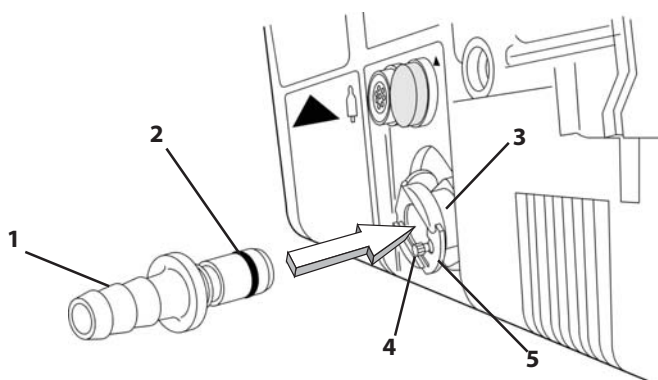
Before connecting the oxygen supply, ensure that the stud on the oxygen connector ([Figure 6-15](#), item 3) is protruding outwards.

Inspect the oxygen coupler ([Figure 6-16](#), item 2) before use to ensure it has its black O-ring attached and in good condition. Do not use an oxygen coupler with a missing, damaged, or worn O-ring.

**To connect the oxygen supply system to the ventilator:**

Refer to [Figure 6-16](#) as required:

1. Inspect the oxygen supply's connector ([Figure 6-16](#), item 1) to ensure that connector's black O-ring (item 2) is not missing.
2. Push the oxygen supply's oxygen connector (item 1) into the ventilator's oxygen connector ([Figure 6-16](#), item 3).
  - the ventilator's oxygen connector's locking stud (item 4) retracts.
  - the ventilator's oxygen connector's locking tab (item 5) is released, ensuring that the oxygen connection is locked and secured in place.



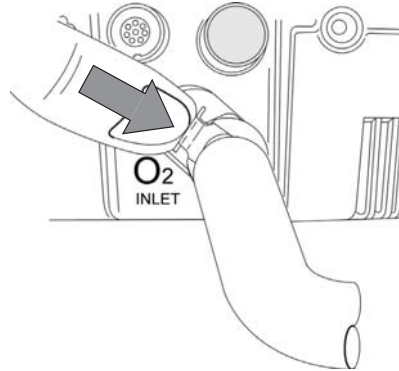
**Figure 6-16.** Connecting the Oxygen Supply System

### To disconnect the oxygen supply system from the ventilator:

**Note:**

Ensure the oxygen source is turned off prior to placing the ventilator in Standby or turning off the ventilator.

1. Stop the oxygen flow from the oxygen supply.
2. Press the locking tab of the ventilator's oxygen connector, as shown in [Figure 6-17](#), to unlock the oxygen connection.



**Figure 6-17.** Disconnecting the Oxygen Supply System

3. Disconnect the oxygen supply's oxygen connector by pulling it towards you.  
The ventilator's oxygen connector's locking stud ([Figure 6-16](#), item 4) will then extend outwards, which is required before the oxygen connector can be reconnected.



**WARNING**

**The coupler must not remain connected to the oxygen connector unless it also connected to a leak-proof, external oxygen gas source. When an oxygen supply is not being used with the ventilator, disconnect the oxygen source completely from the ventilator.**

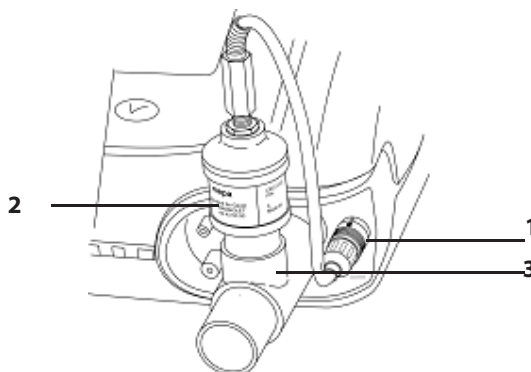
**In the event of an oxygen leak, shut down the supply of oxygen at its source. In addition, remove and/or keep any incandescent source away from the device, which may be enriched with oxygen. Circulate fresh air into the room to bring the oxygen level down to normal.**


**To prevent any interference with the internal sensors of the ventilator, do not install a humidifier upstream of the ventilator.**

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### 6.8.3 Connecting the FIO<sub>2</sub> sensor

When administering oxygen it is recommended to use a FiO<sub>2</sub> oxygen sensor that can be connected to the front of the apparatus by means of a FiO<sub>2</sub> measurement kit.

**To install the FiO<sub>2</sub> sensor:****Figure 6-18.** Connecting the FiO<sub>2</sub> sensor

1. Remove the sensor from the airtight packaging.
2. Install the FiO<sub>2</sub> connector to the FiO<sub>2</sub> socket on the ventilator (item 1)
3. Connect the FiO<sub>2</sub> sensor (item 2) onto Ø15mm adaptor (item 3).
4. Install the adaptor on the TO PATIENT  outlet port, as shown.

Fit the patient circuit after the adaptor.

**Note:**

When using a new sensor, allow its temperature to become stable for about 20 minutes in ambient air before installing it, calibrating it and starting ventilation.

## 6.9 Mounting the Ventilator on a Wheelchair

**WARNING**

Due to its limited internal battery's reserve capacity, the ventilator should only be operated on the internal battery when no other power source is available. Ensure that the internal battery never becomes fully discharged.

Do not operate the ventilator in direct sunlight, near heat sources, outdoors, or near installations where liquid may pose a risk without first providing adequate protection for the device.

To avoid damage to the ventilator, in particular the batteries or electrical components, fluids must not be allowed to enter the device, particularly through the air inlet filter or the cooling apertures located in the side, rear, and bottom panels of the ventilator.

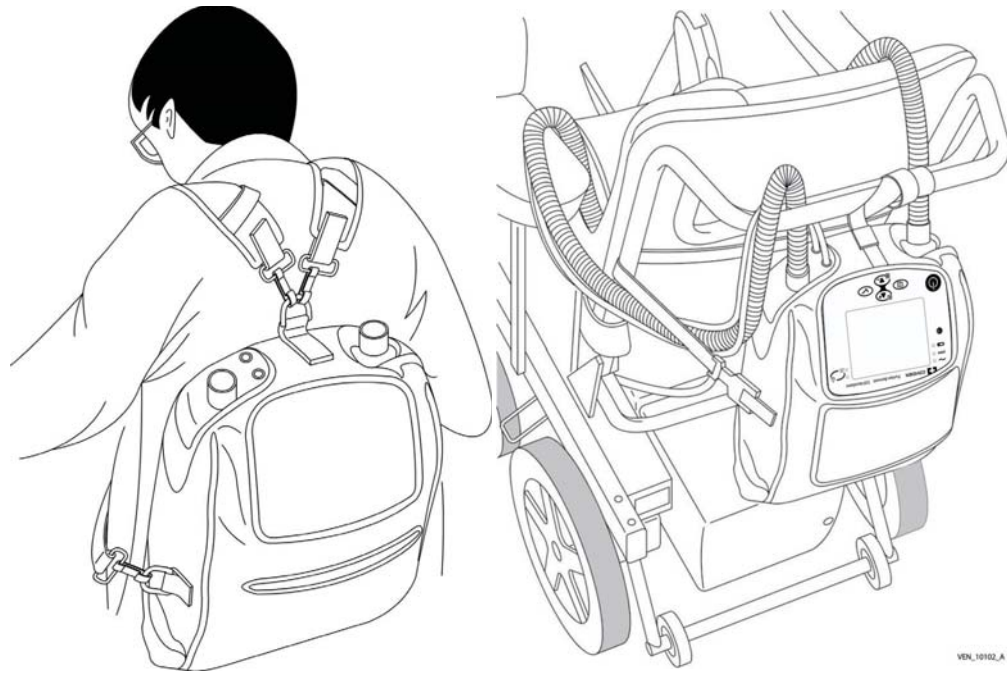
If exhaled tidal volume measurements are required to ensure correct patient ventilation a double limb patient circuit configuration must be used in order to detect leaks. In this case, both the minimum and maximum VTE alarm parameters must be properly set to warn in the event of patient suffocation.

To minimise the risk of damage, you must use the ventilator's Dual Bag to transport the ventilator. See Table H-1, [List of Consumables and Accessories](#)

Before using the ventilator's internal battery, ensure that the battery is fully charged and that the charge holds. Back up ventilators or those in storage should be connected to an AC power source to protect the integrity of the battery.

The Dual Bag accessory consists of a carrying bag that allows the Puritan Bennett™ 560 Ventilator to be both mounted onto a wheelchair or carried as a backpack (see [Figure 6-19](#)).

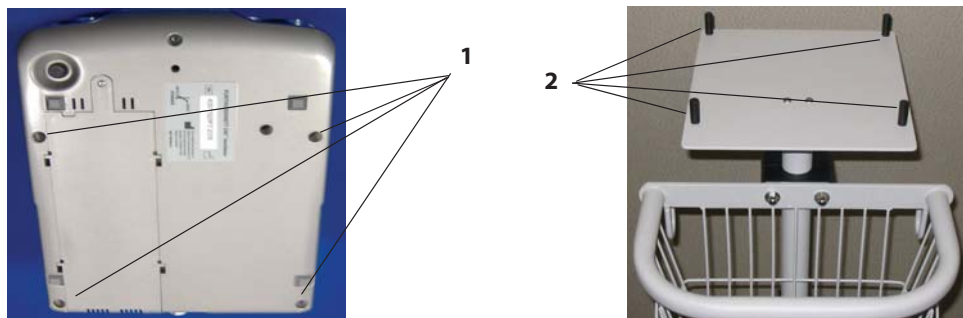
Refer to the Dual Bag's instructions for further information.



**Figure 6-19.** Using the Dual Bag Accessory

## 6.10 Mounting the Ventilator on the Utility Cart

Match the mounting holes (item 1) on the bottom of the Puritan Bennett™ 560 Ventilator to the mounting studs (item 2) on the top of the utility cart platform.





## 6.11 Connecting the Nurse Call Cable

Connect the Nurse Call cable (Figure 6-20, item 1) to the Nurse Call Monitor Connector (item 2).



**Figure 6-20.** Connecting the Nurse Call Cable



### WARNING

**Before using the Nurse Call system, ensure that its connections are secure and it operates properly. For more information, contact Covidien.**

**To connect the ventilator to a Nurse Call device, contact Covidien to check the ventilator's compatibility with the Nurse Call device and order a suitable connection cable.**

**Before using the Nurse Call system, ensure that its connections are secure and it operates properly.**

**Do not use Nurse Call devices that operate based on the closure of an electrical circuit, because the devices often do not take into account possible cable disconnection or a total loss of power. Ensure that the Nurse Call device is always connected to the ventilator.**

The Nurse call function provides for remote alerts of ventilator alarm conditions (for example, when the ventilator is used in an isolation room), and features the following:

- The ventilator signals an alarm using a normally open (NO) or a normally closed (NC) signal.
- A remote alarm is activated when an alarm condition occurs, unless either of the following is true:
  - The audio paused function is active.
  - The ventilator power switch is OFF.
- The remote alarm port is an 8-pin female connector; allowable current is 100mA at 24VDC(max).

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# 7 Operating Procedures

## 7.1 Turning on the Ventilator



### WARNING

Before operating the ventilator, read, understand, and strictly follow the information contained in Chapter 1, "Safety Information".

If the ventilator has been transported or stored at a temperature that differs more than  $\pm 20^{\circ}\text{C}$  ( $\pm 36^{\circ}\text{F}$ ) from the temperature in which it will be operating, the ventilator should be allowed to stabilise in its operating environment for at least two (2) hours prior to use.

To reduce the risk of a fire hazard, keep matches, lighted cigarettes, and all other sources of ignition (such as flammable anesthetics and/or heaters) away from the ventilator and oxygen hoses.

While the ventilator is in use, an alternative means of ventilation should always be available in the event of a ventilator problem. This is particularly true for ventilator-dependent patients. Supplementary observation, appropriate for the patient's condition, is also recommended.

To ensure that ventilation continues uninterrupted, ensure alternative power sources are available (AC power source, extra batteries, or an auxiliary DC car adapter). Be prepared for the possibility of power failure by having an alternative means of ventilation ready for use—particularly for ventilator-dependent patients.

Do not start ventilation until you ensure that the device is suitably assembled, that the air inlet filter is properly installed and is not obstructed, and that there is proper clearance all around the unit. Also ensure that the patient circuit is suitably connected to both the ventilator and the patient and that the patient circuit, including all hoses, is not damaged or obstructed.

Users must always possess an additional breathing circuit and exhalation valve while using the Puritan Bennett™ 560 Ventilator.

Verify the functionality of the alarm conditions before connecting the patient to the ventilator. Refer to chapter F, "Alarms Tests"

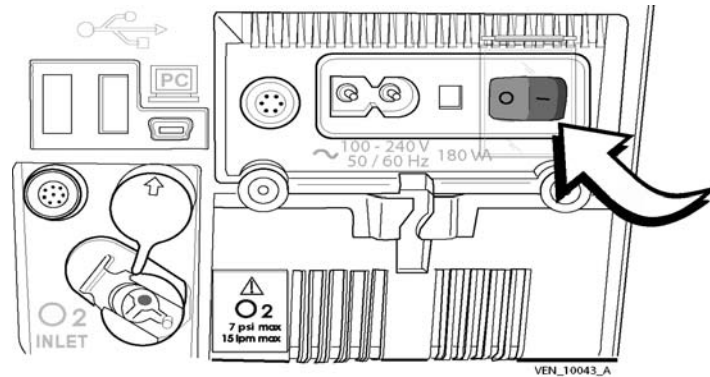
Before starting ventilation, always verify that all settings are properly set in accordance with the required prescription.

If the ventilator fails the alarm tests or if you cannot complete the tests, refer to chapter 5.8, "Troubleshooting" or call your equipment supplier or Covidien.

Due to its limited internal battery's reserve capacity, the ventilator should only be operated on the internal battery when no other power source is available. Ensure that the internal battery never becomes fully discharged.

### To turn the ventilator on:

- Set the **I/O** switch (a covered, rocker-type switch located at the rear of the ventilator) to the **I** position, as shown in [Figure 7-1](#) below.



**NOTE:** I/O switch cover not shown here.

**Figure 7-1.** Turning on the Ventilator

The following events occur:

- The ventilator is powered on.
- A Power On Self Test (POST) is carried out (when plugged in to an AC power source).
- The front panel indicators flash (except for the indicator showing the type of power supply in use, which remains lit).
- The audible alarms briefly sound.
- The display's backlight turns on.
- The PURITAN BENNETT logo is displayed momentarily.
- The blue **VENT STDBY** indicator to the right of the **VENTILATION ON/OFF** [Power] key illuminates, indicating the device is in standby mode.
- A Welcome Menu screen is displayed for about five (5) seconds, which includes the machine counter and the patient counter, as shown in [Figure 7-2](#).



**Figure 7-2.** Welcome Menu Screen

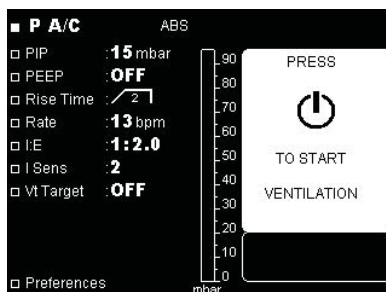
**Note:**

If the ventilator had been previously stopped by use of the **I/O** switch while ventilation was in progress, the ventilator starts directly in ventilation mode and does not show the Welcome Menu screen.

The Alarm, Technical Fault, and Event logs are stored in non-volatile memory on the Main CPU PCB, ensuring that the information is retained when the ventilator is powered off and during power loss conditions.

**To skip the Welcome Menu:**

- Press **VENTILATION ON/OFF**  to start ventilation immediately.  
The Ventilation menu is then displayed.



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**Figure 7-3.** Ventilation Menu Parameters

By default, the starting ventilation mode is the last one used, the settings being those that were active when the machine was last stopped.

If the ventilator's memory of the settings is faulty, a "CHECK SETTINGS" alarm is activated. If this occurs, the desired parameters should be reset and saved; otherwise the machine will operate on default parameter values.



## 7.2 Setup Menu Parameters

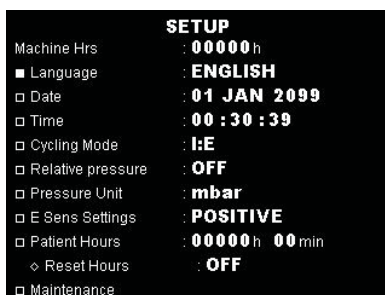
### 7.2.1 Accessing Setup Configuration

**Note:**

The Locking Key prevents access to the Setup menu (refer to section 7.8, "Locking the Control Panel," on page 7-25 and section 7.9, "Unlocking the Control Panel," on page 7-26).

The Setup menu cannot be accessed if the ventilator had been powered off, without first placing the device into standby.

- Check the ventilator's **I/O** switch is set to OFF (O) position.
- Press and hold the **ALARM CONTROL**  key while switching the **I/O** switch to the ON (I). Hold the  key until the Setup menu appears (approximately three seconds). Refer to [Figure 7-4](#)










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**Figure 7-4.** Setup Menu


- Release the **ALARM CONTROL**  key.

## 7.2.2 Changing the Setup Menu Parameters

### To change the Setup Menu settings:

1. Press **UP**  or **DOWN**  to position the cursor beside the parameter to be modified.
2. Press **ENTER** .
  - The cursor changes to: .
  - The selected parameter value flashes.
3. Press **UP**  or **DOWN**  to modify the value of the selected parameter.
4. Press **ENTER**  to confirm the newly selected value.

### Note:

When a parameter contains several setup fields (such as Date and Time) press **ENTER**  to move from one field to the next.

If you do not confirm a change by pressing **ENTER**  before seven (7) seconds elapse, the ventilator restores the setup field's previous value.

### The parameters in this menu are:

- Machine Hours
- Language
- Date
- Time
- Cycling Mode
- Relative pressure
- Pressure Unit
- E Sens settings
- Patient Hours
- Maintenance

### Machine Hours:

The counter records the total ventilation time in hours (to the nearest hour) since manufacture.

### Note:

The machine hour meter is reset when the CPU board is changed.

## Language

The language can be set here. All messages and denominations are automatically displayed in the selected language. The languages available are:

**Table 7-1.** Languages

English (US)	Finnish	Japanese
English (UK)	Russian	Italian
German	Portuguese	Greek
Danish	Polish	French
Chinese	Norwegian	Spanish
Turkish	Dutch	-
Swedish	Korean	-

## Date

The current date can be set here. The date is displayed in the format: DD MMM YYYY.

## Time

The current time can be set here. The time is displayed in the format: HH: MM: SS.

## Cycling Mode

The cycling mode determines the duration of inspiratory time in P A/C and V A/C. It can be set to either **I:E** or **I/T** and enables the operator to set the duration of inspiratory and exhalation phases.

The two cycling modes represent the relationship between inspiration time to exhalation time as follows:

1. I/T: Inspiratory time (Ti) as a percentage of the total breath cycle time (Ti + Te).

$$I/T (\%) = [Ti / (Ti + Te)] \times 100$$

2. I:E The inspiration time (Ti) to exhalation time (Te) ratio.

$$I:E = 1 / (Te / Ti)$$

In P A/C and V A/C modes, the cycling ratio changes based on patient inspiration; however, the inspiratory time remains constant and corresponds to the rate and cycling ratio settings.

### Note:

When adjusting I:E or I/T ratio, the corresponding calculated Ti is displayed below the parameter zoom in the monitoring and information window.

## Absolute and Relative Pressure

The relative pressure for the inspiratory pressure setting (P Control and P Support) in PSV, P A/C, and P SIMV, can be set to **OFF** or **YES** and allows the choice between setting the inspiratory pressure relative to PEEP or setting an absolute inspiratory pressure. The default value is absolute (ABS).

If relative pressure is set to **YES**, the PEEP is added to the inspiratory pressure setting to determine the peak inspiratory pressure. If relative pressure is set to **OFF**, the inspiratory pressure setting will determine the peak inspiratory pressure regardless of the PEEP setting.

Relative pressure = YES: Inspiratory pressure setting + PEEP = Peak Inspiratory pressure.

Relative pressure = OFF (ABS): Inspiratory pressure setting = Peak Inspiratory pressure

The symbol **ABS** for absolute or **REL** for relative will be displayed at the top of the screen as follows:

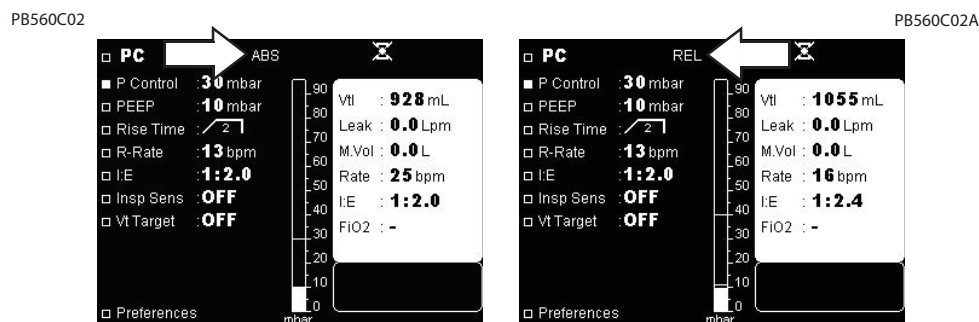


Figure 7-5. Absolute and Relative Pressure

### Pressure Unit

The unit of pressure can be set here. It can be displayed as **mbar**, **cmH2O** or **hPa**.

### E Sens Settings

E Sens enables the operator to adjust the sensitivity of the expiratory trigger in pressure support breaths in PSV, P SIMV and V SIMV modes which will cycle the breath into the expiratory phase. During a Pressure Support inspiration the delivered flow will reach a peak value and then begin to decelerate toward zero. The E Sens setting allows the operator to set the flow value, as a percentage of peak flow, that will cycle the breath to exhalation. The E Sens setting can be set to either **POSITIVE** or **NEGATIVE**.

If set to **POSITIVE**, E Sens is based on the percentage of inspiratory peak flow. If set to **NEGATIVE**, E Sens is based on the percentage of inspiratory peak flow by which the flow must decrease before exhalation is declared.

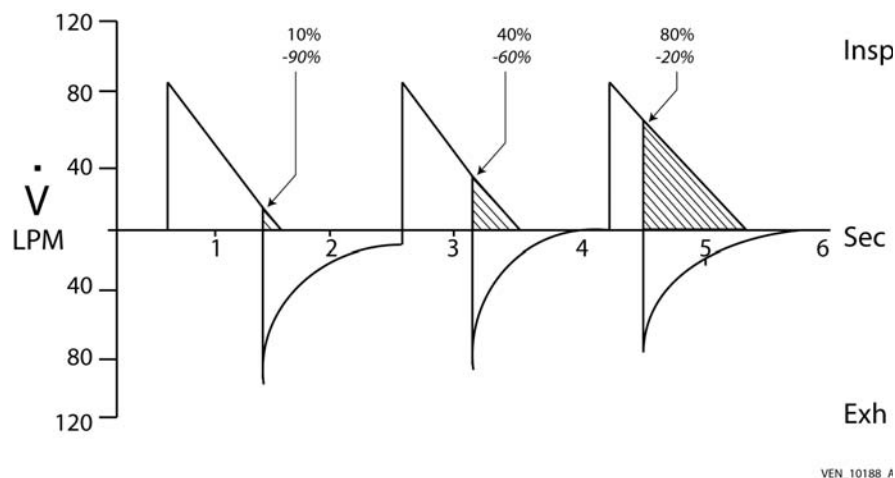


Figure 7-6. E Sens Settings


### Patient Hours

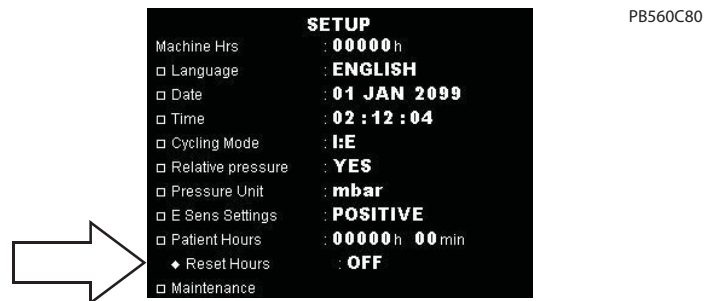
The value of this parameter is equal to the total number of hours that the patient has been ventilated.

**Note:**





Resetting the patient hours will also reset the trends stored in the device memory in preparation for a new patient.

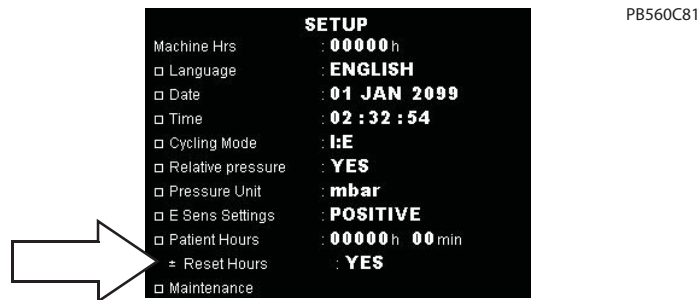
**To reset the Patient Hours counter to zero:**

1. Press **DOWN**  to place the cursor at the "Patient Hours" line, as shown in the following graphic




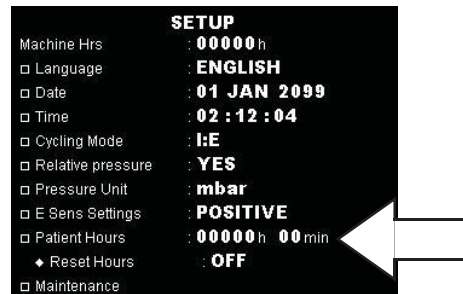
**Figure 7-7.** Resetting Patient Hours to Zero (1)

2. Press **ENTER**  .
  - The cursor is placed on the "Reset Hours" line: OFF".
3. Press **ENTER**  .
  - "OFF" flashes.
4. Press **UP**  or **DOWN**  to change the "OFF" message to "YES", as shown in the following graphic:



**Figure 7-8.** Resetting Patient Hours to Zero (2)

5. Press **ENTER**  .
  - "YES" is displayed continuously.
  - A long "beep" sounds.
  - The patient counter display indicates 00000h, as shown in the following graphic:



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Figure 7-9. Resetting Patient Hours to Zero (3)

6. Press **UP** or **DOWN** .

- The display indicates “Reset Hours: OFF”, as shown in the following graphic.



PB560C52

Figure 7-10. Resetting Patient Hours to Zero (4)

### Maintenance

This option is reserved for maintenance operators qualified by Covidien to ensure correct maintenance and operation of the device. For information on using the Maintenance option, refer to the Puritan Bennett™ 560 Ventilator Service Manual.

## 7.2.3 Exiting the Setup Screen

To exit the SETUP Screen, you must cycle the ventilator's power.

- Set the ventilator's rear panel **I/O** switch to OFF (O) . Wait 30 seconds.
- Set the ventilator's **I/O** switch ON (I).

The ventilator will run through a Power On Self Test (POST) routine and then return to Standby mode.

## 7.3 Preferences Menu Parameters

The Preferences menu is only accessible if the Locking Key has not been enabled (refer to section 7.8, “Locking the Control Panel,” on page 7-25 and section 7.9, “Unlocking the Control Panel,” on page 7-26).

The Preferences menu is accessed from the Ventilation Parameters menu, when ventilation is either on or off.



### WARNING




Setting Alarm limits to extreme values can cause the ventilator alarms to malfunction.

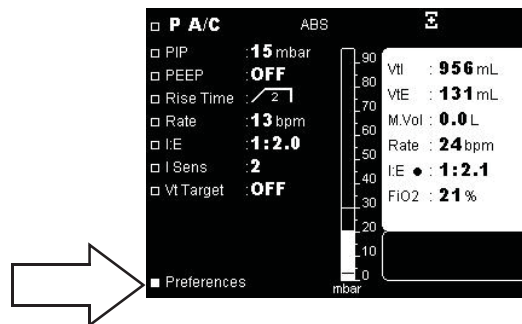
**Note:**

Default alarm setting preferences should be entered prior to using the ventilator.

### 7.3.1 Preferences Menu

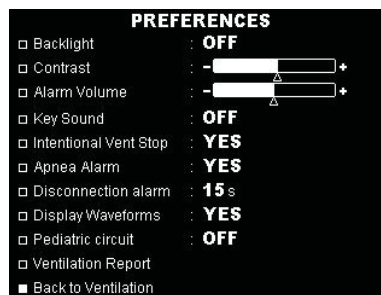
**To display the Preferences menu:**

1. Press **DOWN**  several times, or continue to press **DOWN** , until the cursor is on the "Preferences" line, as shown in the following graphic:
2. Press **ENTER** . The Preferences menu is displayed.



PB560C53




**Figure 7-11.** Selecting the Preferences Menu



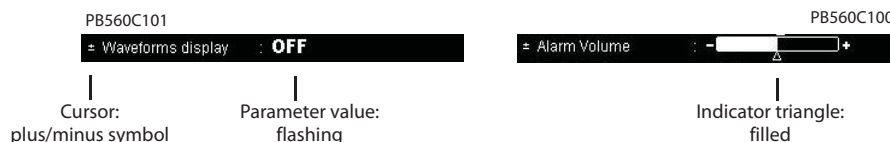
PB560C54




**Figure 7-12.** Changing Settings in the Preferences Menu


**To change the settings in the Preferences menu:**

1. Press **UP**  to place the cursor on the parameter line to be modified.
2. Press **ENTER** .
  - The cursor changes to the plus/minus  symbol.
  - The parameter selected to be modified flashes, or for certain parameters featuring a bar graph, the indicator triangle under the bar graph becomes filled.

Refer to the following graphics.



3. Press **UP**  or **DOWN**  to change the selected parameter's value.
4. Press **ENTER**  to confirm the new parameter setting.
  - The new parameter setting is displayed.
  - The cursor returns to its initial form.


If a parameter change is not confirmed by pressing **ENTER**  before seven (7) seconds elapse, the ventilator resets the parameter to its previous value.

**The parameters in this menu are:**

- Backlight
- Contrast
- Alarm Volume
- Key Sound
- Intentional Vent Stop Alarm
- Apnea Alarm
- Disconnection Alarm
- Waveforms Display
- Pediatric Circuit
- Ventilation Report

To adjust the various Preferences menu parameters, or to view the Ventilation Report, refer to the instructions provided in this section.

**To manually exit from the Preferences menu:**

- Press **ENTER**  when the cursor is on the "Back to Ventilation".

**You will automatically exit from the Preferences menu when:**

- No keyboard action is detected before 15 seconds elapse, or
- A High Priority alarm is triggered.

## 7.3.2 Backlight

**To set the Backlight:**

1. Select the Backlight parameter on the display.
2. Set the backlight:

- a. To set the backlight to *standby*, select **OFF**.

The effect of this setting is that if no keyboard action occurs before one minute elapses, the display's backlight fades almost to off. The display will illuminate when the following occurs:

- Any one of the keys on the keyboard is pressed
- An alarm is triggered
- b. To set the backlight to *light continuously*, select **YES**. This setting ensures that the display is continuously lit.

**Note:**


If running the ventilator on its internal battery or on an external battery, we recommend keeping the backlight setting to OFF to reduce power consumption.

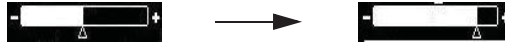
3. Confirm the new Backlight setting before seven (7) seconds elapse.

The default setting for Backlight is **YES** (backlight lit continuously).


### 7.3.3 Contrast

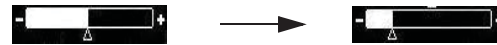
#### To set the Contrast:

1. Select the Contrast parameter on the display.
2. Set the Contrast level:
  - a. To *increase* the contrast, press **UP** . This change can be observe as the cursor moves to the right:






The display contrast progressively increases.

- b. To *decrease* the contrast, press **DOWN** . This change can be observe as the cursor moves to the left:



The display contrast progressively decreases.

3. Confirm the new Contrast setting by pressing **ENTER**  before seven (7) seconds elapse.

When ventilation is stopped, the contrast can also be changed directly from the currently displayed menu by pressing **ALARM CONTROL**  continuously, while repeatedly pressing **UP**  or **DOWN** .

The default setting for Contrast is the medium setting (the middle of the bar graph).


### 7.3.4 Alarm Volume

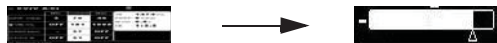


#### WARNING

**The sound level of the alarms should be adjusted according to the installation environment and the size of the area monitored by the patient's caregiver. Ensure that the alarm sound apertures at the front of the device are never obstructed.**

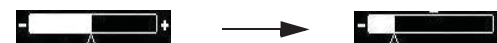
#### To set the Alarm Volume:

1. Select the Alarm Volume parameter on the display.
2. Set the Alarm Volume level:
  - a. To *increase* the sound level of alarms, press **UP** . This change can be observed as the cursor moves to the right:



The buzzer activates and increases in sound level as the setting increases.

- b. To *decrease* the sound level of alarms, press **DOWN** . This change can be observed as the cursor moves to the left:



The buzzer activates and decreases in sound level as the setting decreases.




3. Confirm the new Alarm Volume setting before seven (7) seconds elapse.

Current hospital standards require a minimum sound level of 55 dB(A) at a distance of 3 metres (9.84 feet), which corresponds to the lowest possible volume setting. The alarm sound level range is 65 dB(A) to 85dB(A) measured at 1 metre (3.28 feet). If a high priority alarm is not paused within 60 seconds of activation, the sound level automatically raises to 85 dBA regardless of the original setting. The default setting for Alarm Volume corresponds to a level of 75 dB(A).

### 7.3.5 Key Sound


This setting is used to select the sound emitted when pressing keys on the ventilator's keyboard.

#### To set Key Sound:

1. Select the Key Sound parameter on the display.
2. Select one of the following four options:
  - OFF – No sound is emitted when a key is pressed
  - Key tone – A “clock” sound is emitted when a key is pressed
  - Accept tone – A “beep” sounds when **ENTER**  is pressed to confirm a setting
  - All tones on – A “clock” sound is emitted when all keys are pressed and a beep sounds when **ENTER**  is pressed to confirm a setting
3. Confirm the new Key Sound setting by pressing **ENTER**  before seven (7) seconds elapse.







The default setting for Key Sound is *Accept tone*.

#### Note:

Whatever the selected Key Sound setting, pressing the **VENTILATION ON/OFF**  key triggers a “beep” at ventilation start and a double “beep” at ventilation stop.







### 7.3.6 Intentional Vent Stop Alarm

#### To set the Intentional Vent Stop Alarm:

1. Use the **UP**  or **DOWN**  arrows to place the cursor at the “Intentional Vent Stop” alarm position.
2. Press **ENTER** .
3. Press **UP**  or **DOWN**  to set the message to “YES”.
4. Press **ENTER** .

### 7.3.7 Apnea Alarm

#### To set the Apnea Alarm:

1. Use the **UP**  or **DOWN**  arrow keys to place the cursor at the “Apnea Alarm” position.
2. Press **ENTER** .
3. Press **UP**  or **DOWN**  to set the message to “YES”. Setting the key to “OFF” means the Apnea Alarm will not sound when the ventilator is stopped.
4. Press **ENTER** .



#### WARNING

The Apnea Alarm should be set to YES for ventilator dependant patients.

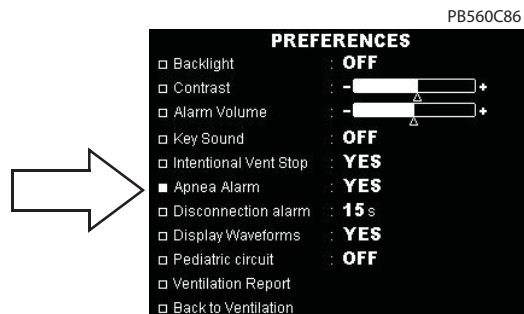








Figure 7-13. Setting the Apnea Alarm

#### Note:

This activates / disactivates the Apnea alarm but not the Apnea Time Setting. The Apnea Time Setting can be set in the Ventilation Menu.

### 7.3.8 Disconnection Alarm

#### To set Disconnection Alarm:

1. Use the UP  or DOWN  arrow keys to place the cursor at the "Disconnection Alarm" position.
2. Press ENTER .
3. Press UP  or DOWN  arrows to adjust the setting between 5 and 62 seconds.
4. Press ENTER .

#### Note:


Values set in the ventilation mode may supercede disconnection alarm values. Refer to chapter 5, "Alarms and Troubleshooting".

### 7.3.9 Waveforms Display

#### To set Waveforms Display:

1. Select the Waveforms Display parameter on the display.
2. Select either:
  - YES – Displays pressure and flow waveforms as a function of time (refer to section 4.3, 'Waveform Display').
  - OFF – Results in no waveform display; hence, no waveform menu.
3. Confirm the new Waveforms Display setting before seven (7) seconds elapse.

The default setting for Waveforms Display is OFF.

The waveform screen, on which the waveforms are displayed, is accessed using MENU  from the Alarm Setting menu. This screen is available ONLY when ventilation is in progress.






### 7.3.10 Pediatric Circuit

#### To choose a pediatric circuit:

1. Select the Pediatric Circuit parameter on the display.
2. Select either:
  - YES - Selects a pediatric patient circuit
  - OFF - Selects an adult patient circuit
3. Confirm the new patient circuit before seven (7) seconds elapse.

The default setting for Pediatric Circuit is *OFF*

#### To set up the ventilator for a pediatric circuit:




1. Use the **UP**  or **DOWN**  arrows to place the cursor at the "Pediatric Circuit" position.
2. Press **ENTER**.
3. Press **UP**  or **DOWN**  to set the message to "YES." Setting the ventilator to "NO" configures the device for an Adult circuit.
4. Press **ENTER** .

#### Note:

The default setting is "NO" (the ventilator is set for Adult use).

### 7.3.11 Ventilation Report

#### Accessing the Ventilation Report:

1. Use the **UP**  or **DOWN**  arrows to place the cursor at the "Ventilation Report" position.
2. Press **ENTER** .

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VENTILATION REPORT	
Vent Time	8 h 0 min on 27 APR 2007
VtI	310 mL
VtE	310 mL
Paw	14 mbar
Rate	16 bpm
Leak	-
AI	10 Ev/h
Apnea TI	30 s
Spont cyc	98 %
Machine	: 00012 h Patient : 00009 h 45 min
■ Back	

Figure 7-14. Accessing the Ventilation Report

#### Note:

The menu is displayed for five minutes then screen reverts to the Preferences Menu.

#### To exit the Ventilation report:

1. Press **ENTER** .

## 7.4 Setting the Ventilation Mode

The ventilation mode can be changed from the ventilation parameters menu or the alarm parameters menu, as long as the Locking Key is not enabled (refer to section 7.8, "Locking the Control Panel," on page 7-25, and section 7.9, "Unlocking the Control Panel," on page 7-26).

The procedure to change the ventilation mode depends on the ventilation status, as described in section 7.4.1 and section 7.4.2.




#### WARNING

In the SIMV mode the use of a double limb circuit is recommended. The VTE Min setting should remain active in the event that pressure losses are present on the patient circuit downstream from the proximal pressure link. In such cases the "PATIENT DISCONNECTION" alarm would not be systematically activated in case of a disconnection of the circuit.

Most breaths are triggered by the patient. You should carefully modify the inspiration trigger threshold in order to avoid the risk of false triggering or "autotriggering" of the ventilator. For example, Level 1P, the most sensitive mode, is recommended for pediatric use. However, for an adult, this setting may result in autotriggering.

## 7.4.1 Changing Modes While Ventilation is on Standby

To change ventilation modes while on standby:

1. Place the cursor on the first line of the menu (general information line) using the UP  key.

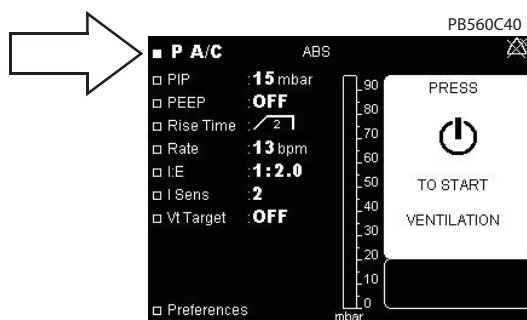








Figure 7-15. Changing Ventilation Modes While on Standby

2. Press ENTER .
  - The cursor changes to: .
  - The mode name flashes.
3. Press UP  or DOWN  until the required mode is displayed.
4. Press ENTER  to confirm the mode selected.
  - The cursor returns to normal.
  - The new mode is displayed with its ventilation parameters.

If the ventilation mode change is not confirmed by pressing ENTER  before seven (7) seconds elapse, the ventilator restores the previous mode.


## 7.4.2 Changing Modes During Ventilation



### WARNING

When changing the mode during ventilation, significant transitions of pressure, flow or cycling rate might occur, depending on the difference between the modes. Before setting the new mode, first ensure that the settings between the different modes are compatible. This reduces the risk of discomfort and harm to the patient.

### Changing ventilation modes during ventilation:

1. Place the cursor on the first line of the menu (general information line) using the **UP**  key.

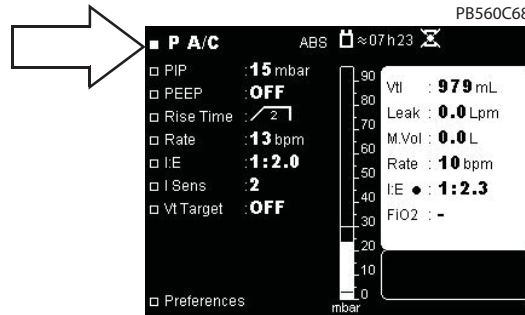







Figure 7-16. Changing Ventilation Modes During Ventilation (1)

2. Press **ENTER** .
  - The cursor changes to: .
  - The mode name flashes.
3. Press **UP**  or **DOWN**  until the required mode is displayed.
4. Press **ENTER**  to confirm the mode selected.
  - The name of the new mode selected is displayed at the top left followed by the flashing "INACTIVE" status indicator (figure below, item 1).
  - The name of the mode in progress is displayed at the top right followed by the continuous "ACTIVE" status indicator (figure below, item 2).
  - The settings for the new mode are displayed on the left (figure below, item 3) and the monitored values for the mode in progress on the right (figure below, item 4).
  - The confirmation line "Accept Mode: YES" is displayed on the bottom left (figure below, item 5).

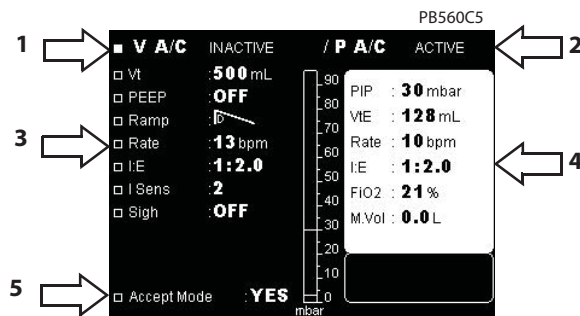




Figure 7-17. Changing Ventilation Modes During Ventilation (2)

The Alarm menu screen is shown below that shows the same active and inactive mode information being displayed, along with the “Accept Mode:Yes” line, alarm parameter settings, and patient values.

PB560C58

■ V A/C INACTIVE				/ P A/C ACTIVE	
	Min	Current	Max		
□ PIP mbar	2	-	40	V <sub>T</sub> :	967 mL
□ V <sub>E</sub> mL	300	129	1000	PEEP :	3 mbar
□ R <sub>tot</sub> bpm	-	17	OFF	M.Vol :	0.0 L
□ FIO <sub>2</sub> %	OFF	21	OFF	I:E :	1:2.3
□ Accept Mode : YES					

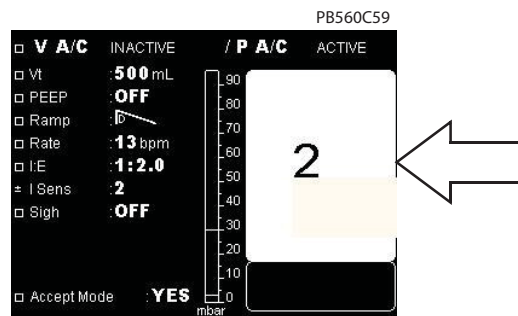
**Figure 7-18.** Changing Ventilation Modes During Ventilation (3)

5. Change the settings of the new mode, including alarms, if necessary.
6. Press **DOWN**  to place the cursor on the “Accept Mode:YES” line.
7. Press **ENTER**  to confirm the mode change.
  - The new mode selected is displayed with its settings. It is applied at the beginning of the next exhalation phase if it occurs during inspiration or immediately if it occurs during exhalation.

It is not mandatory to change modes during ventilation (see steps 6 and 7, above). The settings of the next (“INACTIVE”) mode can be “prepared” while ventilation is in progress in the current (“ACTIVE”) mode. The modifications will be saved for this next mode, whether or not it is used immediately afterwards.

When setting the parameters of the future and currently inactive mode, the monitoring data for the mode in progress are displayed in the window to the right of the menu and also in the central (“Patient”) column of the table on the Alarm menu screen.

When changing the value of a parameter in this inactive mode, the monitoring data displayed in the window on the right side of the screen are temporarily hidden by the display of the value currently being changed. This is shown in the following figure, as the PEEP setting is adjusted in the inactive V A/C mode.



**Figure 7-19.** Changing Ventilation Modes During Ventilation (4)

If an alarm is triggered during the setting of an inactive mode, its message is displayed in the alarm message display.

When the menu of an inactive mode is displayed and no changes are made by the user on the keyboard within 14 seconds, the display of the active ventilation mode in use reappears on the screen and the “Accept Mode:YES” line disappears.

The menu of the active mode can also be recalled without waiting for this delay by directly restoring the name of the mode on the general information line.

The ventilation parameters of the inactive mode and the current mode remain in memory until some or all of the parameters are modified again; this is true even after the machine is stopped.

## 7.5 Setting Ventilation Parameters

Ventilation parameters can be changed as long as the Locking Key is not activated (refer to section 7.9, "Unlocking the Control Panel," on page 7-26).







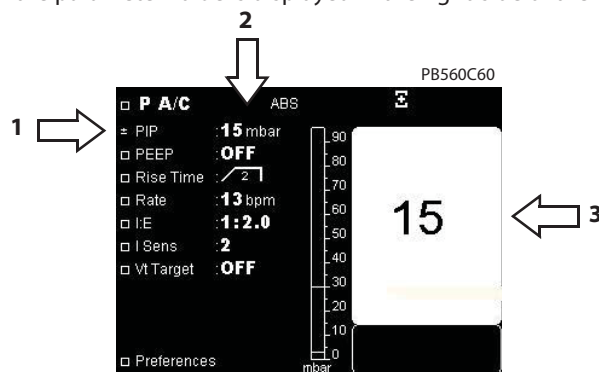
### WARNING

**In adult or pediatric use ensure that the adjusted tidal volume is compatible with the needs of the patient.**




Ventilation is not interrupted by the adjustment of a value. It continues according to previous settings. The new settings are applied **ONLY** after they are confirmed *and* synchronised in the next breath cycle, except for the I Sens setting, which is applied immediately.

#### To modify a ventilation parameter:


1. Place the cursor on the line of the parameter to be modified using the **UP**  or **DOWN**  key.
2. Validate your intention to modify the parameters using the **ENTER**  button. Refer to the figure below.
  - The cursor changes to: . (item 1, below)
  - The parameter value flashes (item 2, below)
  - A zoom of the parameter value is displayed in the right-side of the window (item 3, below).



**Figure 7-20.** Modifying a Ventilation Parameter

3. Press **UP**  or **DOWN**  to select the value desired for the parameter (continuing to press on these keys speeds up the progression of values displayed).
4. Press **ENTER**  to confirm the selected value.
  - The new parameter value is displayed continuously
  - The zoom disappears
  - The cursor returns to normal

#### Note:

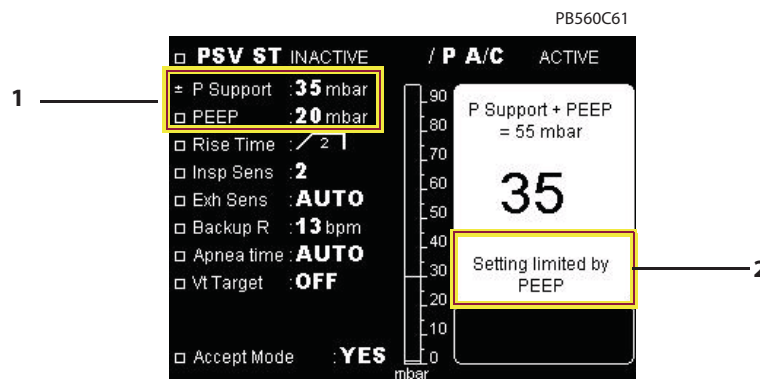
If a parameter change is not confirmed by pressing **ENTER**  before seven (7) seconds elapse, the ventilator restores the parameter's previous value.

### 7.5.1 Links between Ventilation Parameters

The adjustment ranges of certain parameters are limited in order to remain compatible with the levels of other previously set parameters. For additional information on the interdependence between ventilation parameters, refer to chapter 3, “Operating Parameters”.

The message “Setting limited by...” is displayed and identifies the parameter(s) that is (are) blocking the setting.

Figure 7-21, item 1, shows that P Support cannot be set above 35 when PEEP is set to 20 and relative pressure is set to **YES**; this value is limited by PEEP because their sum cannot exceed 55 mbar.



**Figure 7-21.** Setting Links Between Ventilation Parameters

Two possibilities exist in this case:

- Allow the PEEP setting to remain at 20, but the P Support cannot be increased.
- Reduce PEEP so that the P Support setting can be set higher than 35 to ensure that their sum is no greater than 55.

### 7.5.2 Links between Ventilation and Alarm Parameters

Setting a ventilation parameter takes priority over an alarm threshold setting and leads to automatic readjustment of the alarm setting threshold so that the interdependence between the two remains unchanged.

Once the ventilator is in service at the patient’s home, you should use the Locking Key to block access to changing any settings (see section 7.8, “Locking the Control Panel,” on page 7-25).

## 7.6 Setting Alarm Parameters





Alarm parameters can be changed from the Alarm menu, if the Locking Key is not enabled (refer to section 7.8, “Locking the Control Panel,” on page 7-25 and section 7.9, “Unlocking the Control Panel,” on page 7-26).

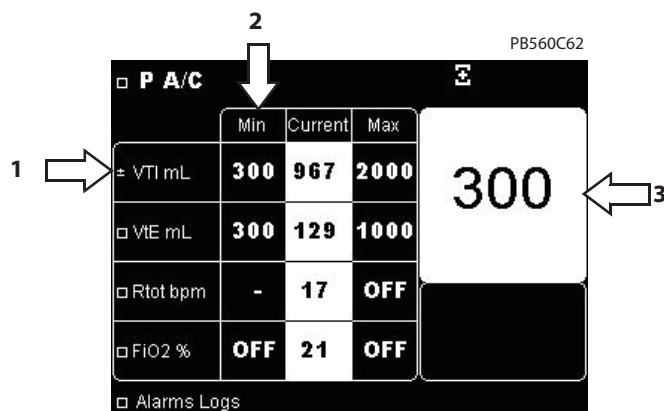
**Note:**

- Adjustable alarms should not be systematically cancelled, they should be adjusted according to the needs and condition of the patient.
- Default alarm setting preferences should be entered prior to using the ventilator.




**To modify an Alarm Parameter:**

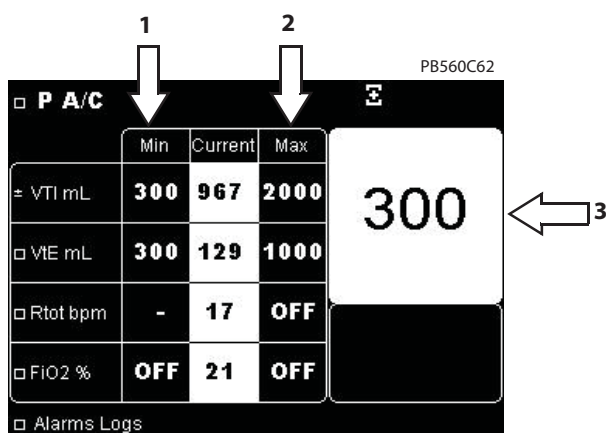
1. Ensure that the Alarm menu is displayed, showing a list of alarm parameters and columns for the minimum, current, and maximum alarm parameter values (Figure 7-22 on page 7-20).

2. Put the cursor next to the alarm parameter to be modified using the **UP**  or **DOWN**  key.
3. Confirm your intention to modify the parameters using the **ENTER**  key.
  - The cursor changes to:  (Figure 7-22, item 1).
  - The parameter in the "Min" column flashes (Figure 7-22, item 2)
  - A zoom of the min parameter is displayed on the right side of the screen (Figure 7-22, item 3).






**Figure 7-22.** Modifying Alarm Parameters – Min Value



4. Press **UP**  or **DOWN**  to modify the value of the parameter.
5. Press **ENTER**  to confirm the value selected.
  - The new value for the "Min" column is continuously displayed (Figure 7-23, item 1).
  - The value of the "Max" column flashes (Figure 7-23, item 2).
  - A zoom of the Max parameter value is displayed on the right side of the window (Figure 7-23, item 3)




**Figure 7-23.** Modifying Alarm Parameters – Max Value

6. Press **UP**  or **DOWN**  to modify the value of the parameter.
7. Press **ENTER**  to confirm the value selected.

- The new value is continuously displayed
- The zoom disappears
- The cursor returns to normal

When an alarm is set to “OFF” (the alarm will not be triggered) automatically when its maximum setting limit (for the Max value) or its minimum setting limit (for the Min value) is reached by successively or continuously pressing **UP**  or **DOWN** , respectively.

If a parameter change is not confirmed by pressing **ENTER**  before seven (7) seconds elapse, the ventilator restores the parameter's previous value.

### Blocking of an Alarm Threshold Linked to a Ventilation Parameter

Setting a ventilation parameter takes priority over an alarm threshold setting. Therefore, if a ventilation parameter is modified when linked to an alarm threshold, the alarm setting threshold is automatically adjusted so that the interdependences linking them are always maintained.

However, if the alarm setting threshold is modified, it cannot be changed beyond the limit of the interdependence with the ventilation parameter to which it is linked. When the alarm setting limit is reached, the message “Setting limited by...” indicates the name of the linked ventilation parameter(s) that are limiting the parameter's setting value.

For more information on the relationship between alarm setting limits and ventilation parameters, refer to chapter 7, “Operating Procedures”.

Four possibilities exist in this case:

- The alarm parameter remains set to “OFF”.
- The alarm parameter setting is changed in relation to the value required at the start and the limits on the ventilation parameter(s) remain unchanged.
- The setting of the ventilation parameter(s) is changed to enable the alarm threshold to be set to the required value.
- The alarm parameter is not set to OFF but the ventilation parameter change has no impact on the alarm setting.



#### WARNING

**The level of inspiratory resistance of the circuit and accessories (bacteria filter, humidifier) must be as low as possible. Settings—particularly the PATIENT DISCONNECTION alarm, maximum inspired volume (Max VTI), and minimum inspired volume (Min VTI) settings—must be periodically adjusted according to changes in the patient circuit resistance—especially when filters are replaced.**

**Adjustable alarms should not be systematically cancelled; instead, they should be adjusted according to the needs and condition of the patient.**

## 7.7 USB Menu Parameters

The USB menu is accessible even if the Locking Key has been enabled (refer to section 7.8, “Locking the Control Panel,” on page 7-25 and section 7.9, “Unlocking the Control Panel,” on page 7-26).

The USB menu is automatically displayed when the USB memory device is connected to the ventilator, when ventilation is either on or off.

Only one USB memory device shall be connected at any time, otherwise an error message will be displayed. The USB Menu is not accessible from the Setup Menu or Maintenance menu.

To access patent data via a PC, a dedicated software package, Puritan Bennett™ respiratory insight software, is available for Clinicians. Contact Covidien or your Puritan Bennett product representative for further information.

### 7.7.1 USB Memory Device Specifications

**Table 7-2.** USB Memory Device Specifications

Characteristics	Supported Formats
USB compatibility	USB flash memory USB 2.0 or USB 1.1, 32 bit format
Number of files	Maximum 999 (sector size: 512-2,048 bytes)
USB size	128 Mb to 4Gb (To guarantee accuracy of transfer time, at least 10% of the USB memory device capacity must be free).


### 7.7.2 USB Menu

**To access the USB menu when a USB memory device is connected:**

Press the **MENU**  key several times, until the USB Menu appears:



**Figure 7-24.** Selecting the USB Menu

In case of high priority alarm activation the ventilator will automatically display the alarm page. To return to the USB Menu, press the **MENU**  key.

The adjustable parameters in this menu are:

- Transfer continuously
- Transfer trends
- Erase key

### 7.7.3 Transfer Continuously

Up to 48 hours worth of data can be transferred from a ventilator to a USB memory device.

To record continuously, the USB memory device must be permanently connected to the ventilator and ventilation is active.

The following data will be recorded to the USB memory device:

- Monitoring: pressure, inspired flow, exhaled flow and leak waveforms.
- Trends: leaks, VTI, VTE, Rate, I:E, M. Vol, PIP and PEEP measurements.

The data can be accessed by a doctor or service provider using the Puritan Bennett™ respiratory insight software.



**Figure 7-25.** Selecting Transfer Continuously

**To transfer continuous data from a ventilator to a USB memory device:**

1. Use the **UP** or **DOWN** arrow keys to place the cursor at the “Transfer Continuously” position.
2. Press **ENTER** .
  - The cursor changes to the plus/minus symbol.
  - The parameter selected to be modified flashes.
3. Press **UP** or **DOWN** to change the selected parameter’s value.
4. Press **ENTER** to confirm the new parameter setting.
  - The new parameter setting is displayed continuously.
  - The cursor is placed at the **STOP** position.
5. To manually stop continuous transfer, press the **ENTER** key.

If a parameter change is not confirmed by pressing **ENTER** before seven (7) seconds elapse, the ventilator resets the parameter to its previous value.

**Note:**

All ventilator menus remain accessible during transfer time.

The message “TRANSFER IN PROGRESS... REMAINING TIME” is displayed during the transfer time.

Other functions of the USB memory device are not available during continuous recording,

If the memory capacity on the USB memory device is insufficient the message “TRANSFER NOT ALLOWED - USB CAPACITY INSUFFICIENT” is displayed and data transfer is not allowed. Delete the data on the USB memory device before restarting data transfer. Refer to deletion process. (Refer to chapter 7.7.5 , “Erase Data from the USB Memory Device”)

In case of USB memory device disconnection or transfer error, the message “TRANSFER ERROR - USB DISCONNECTION” or “TRANSFER ERROR - TECHNICAL PROBLEM” is displayed. In this case restart the transfer process. If the problem persists contact your technical service.

## 7.7.4 Transfer Trends

Up to one year’s worth of trend data can be transferred from a ventilator to a USB memory device.

Ventilation trends such as leaks, VTi, VTE, Rate, I:E, M, Vol, PIP and PEEP measurements can be transferred from the ventilator to a USB memory device.

The data can be accessed by a doctor or service provider using the Puritan Bennett™ respiratory insight software.

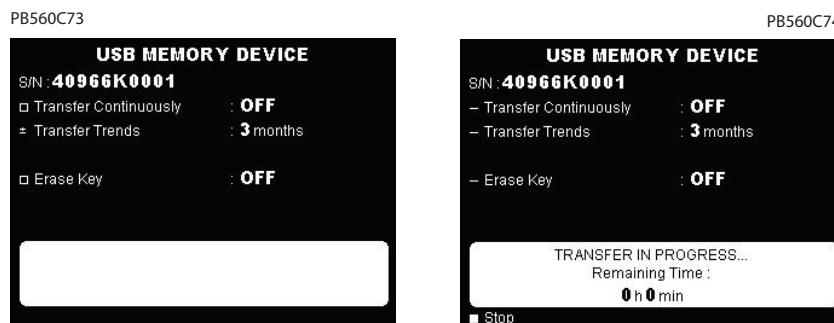


Figure 7-26. Selecting Transfer Trends

**To transfer trend data from a ventilator to a USB memory device:**

1. Use the **UP** or **DOWN** arrow keys to place the cursor at the “Transfer Trends” position.
2. Press **ENTER** .
  - The cursor changes to the plus/minus symbol.
  - The parameter selected to be modified flashes.
3. Press **UP** or **DOWN** to change the selected parameter’s value.
4. Press **ENTER** to confirm the new parameter setting.
  - The new parameter setting is displayed continuously.
  - The cursor is placed at the **STOP** position.
5. To manually stop trend transfer, press **ENTER** .

If a parameter change is not confirmed by pressing **ENTER** before seven (7) seconds elapse, the ventilator resets the parameter to its previous value.

**Table 7-3.** Time taken to transfer trends data from the ventilator to a USB memory device

Amount of trends data (in months)	Transfer time from ventilator to USB memory device
3 months	Approximately 2 minutes
6 months	Approximately 4 minutes
9 months	Approximately 6 minutes
12 months	Approximately 8 minutes

**Note:**

The message “TRANSFER IN PROGRESS... REMAINING TIME” is displayed during the transfer time.







Other USB memory device functions are available during transfer of trends.

If the memory capacity on the USB memory device is insufficient the message “TRANSFER NOT ALLOWED - USB CAPACITY INSUFFICIENT” is displayed and data transfer is not allowed. Delete the data on the USB memory device before restarting data transfer. Refer to deletion process. (Refer to chapter 7.7.5 , “Erase Data from the USB Memory Device”)

In case of USB memory device disconnection or transfer error, the message “TRANSFER ERROR - USB DISCONNECTION” or “TRANSFER ERROR - TECHNICAL PROBLEM” is displayed. In this case restart the transfer process. If the problem persists contact your technical service.

## 7.7.5 Erase Data from the USB Memory Device

To erase data from the USB memory device:

1. Use the **UP**  or **DOWN**  arrow keys to place the cursor at the “Erase key” position.
2. Press **ENTER** .
  - The cursor changes to the plus/minus symbol.
  - The parameter selected to be modified flashes.
3. Press **UP**  or **DOWN**  to change the selected parameter’s value.
4. Press **ENTER**  to confirm the new parameter setting.
  - The new parameter setting is displayed continuously.
  - The cursor is placed at the **STOP** position.

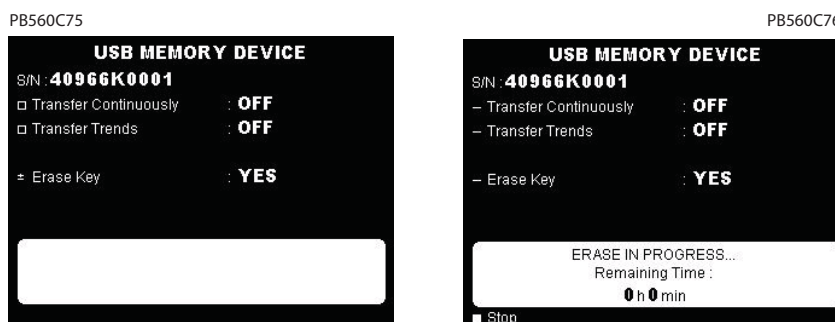


Figure 7-27. Erasing Data from the USB Memory Device



### WARNING

Deletion erases **ALL** files present on the USB memory device.

### Note:

The message “ERASE IN PROGRESS... REMAINING TIME” is displayed during the deletion time.

The deletion time of a full USB memory device is less than one minute.

Other USB memory device functions are not available during deletion.

Once deletion of the USB memory device has been started, it cannot be paused, stopped or cancelled.

All ventilator menus remain accessible during deletion.

In case of USB memory device disconnection or deletion error, the message “TRANSFER ERROR - USB DISCONNECTION” or “ERASE ERROR - TECHNICAL PROBLEM” is displayed. In this case restart the transfer process. If the problem persists contact your technical service.



## 7.8 Locking the Control Panel

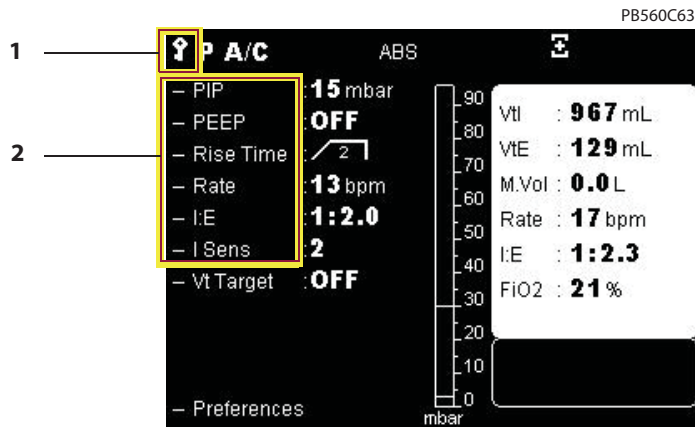
When the machine is in service at a patient’s home, it is strongly recommended that you prevent accidental or unauthorised ventilator adjustments from occurring by enabling the Locking Key.

The Locking Key is a software function that prohibits access to the ventilation and alarm parameter settings and changes to the ventilation mode.

**To enable the Locking Key:**

Simultaneously press the **UP**  and the **DOWN**  keys for at least six (6) seconds.

- The Locking Key  symbol (Figure 7-28, item 1) appears in the top left corner of the screen.
- Lines which are no longer accessible are preceded by a dash “-” (Figure 7-28, item 2).
- Lines which remain operational keep their initial line access  symbol.





**Figure 7-28.** Installing the Locking Key

## 7.9 Unlocking the Control Panel

**To disable the Locking Key:**

Simultaneously press the **UP**  and the **DOWN**  keys for at least six (6) seconds.

- The Locking Key  symbol disappears.
- The initial line access  symbol is displayed in front of each line.


## 7.10 Starting Ventilation

Before starting ventilation, refer to [Appendix E, “Operational Verification Checklist”](#), and set the parameter values in the Preferences menu (refer to section 7.3, “Preferences Menu Parameters,” on page 7-8).

**WARNING**

**Verify the functionality of the alarm conditions before connecting the patient to the ventilator.**

**Before starting ventilation, ensure that the device is properly assembled and that the air inlet, cooling vents, and alarm sound diffusion holes are not obstructed. Ensure also that the patient circuit is of the proper configuration (double or single limb), properly connected to the ventilator, and that the circuit hoses are neither damaged nor compressed and contain no obstructions or foreign bodies.**

When the ventilator is in standby (the ventilator is on, but ventilation has not started), a message that prompts the ventilator operator to press **VENTILATION ON/OFF**  to start ventilation is displayed in the right-hand window of the ventilation and alarm menus (Figure 7-29).

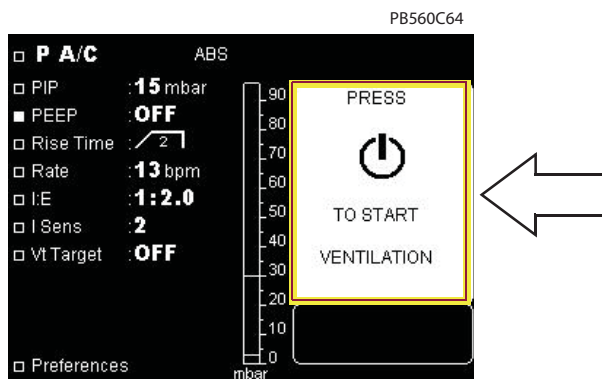



Figure 7-29. Prompt to Start Ventilation

### To start ventilation:

Press and release **VENTILATION ON/OFF**  (Figure 7-30, item 1).

- The blue light indicator, at the upper right of the **VENTILATION ON/OFF**  key (see Figure 7-30, item 2), turns off.
- A “beep” sounds.
- The ventilation starts.
- The values of the monitored parameters are displayed in the right-hand window.

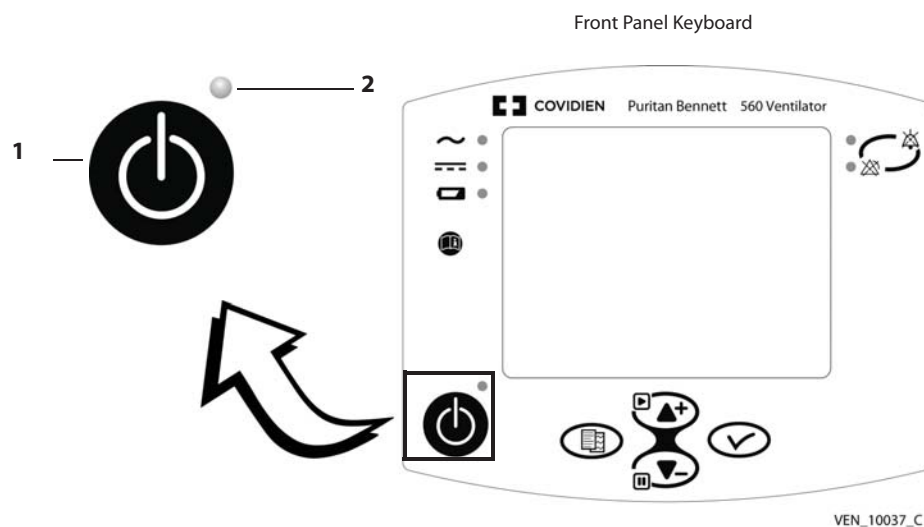


Figure 7-30. Starting Ventilation

## 7.11 Stopping Ventilation




### WARNING

Do not allow a patient to remain connected to the ventilator when ventilation is stopped, because a substantial quantity of expiratory gas, primarily carbon dioxide, may be inhaled by the patient. In some circumstances, inhaling carbon dioxide may lead to under-ventilation, suffocation, and serious injury or death.

You can stop your ventilator at any time.

### To stop the ventilator:

1. Hold down the **VENTILATION ON/OFF**  key (Figure 7-30, item 1) for about three (3) seconds.
  - A message prompting the user to keep the button pressed appears on the monitoring window, as shown in the graphic below:

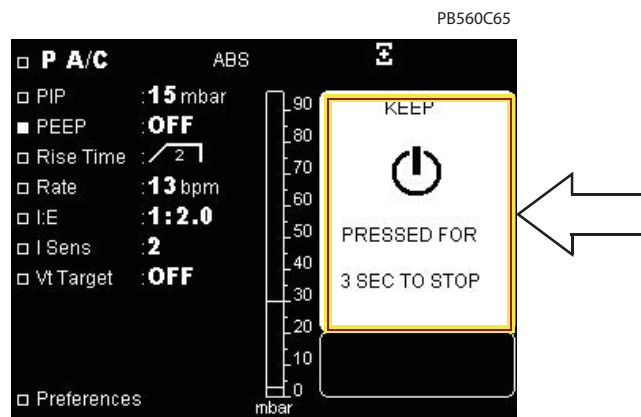


Figure 7-31. Stopping Ventilation (1)

- While keeping the **VENTILATION ON/OFF**  key pressed, a new message appears that directs the user to release the key to stop ventilation (shown in the graphic below).

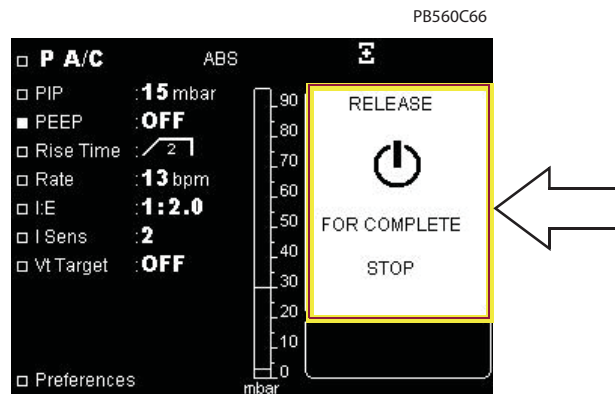




Figure 7-32. Stopping Ventilation (2)

- A double “beep” sounds.
2. Release the **VENTILATION ON/OFF**  key:
    - Ventilation stops.

- The blue LED located to the upper-right of the **VENTILATION ON/OFF**  key (Figure 7-30, item 2) illuminates to indicate ventilation is on Standby.
- A prompt for a new start of ventilation is displayed (see Figure 7-29 on page 7-27).

## 7.12 Turning Off the Ventilator




### **WARNING**

**When the ventilator is switched back on, it will immediately begin ventilating—without the user first having to press the VENTILATION ON/OFF  key.**

**Handle the ventilator with care after use, particularly when ambient temperatures are high. Some ventilator surfaces may be very hot, even if safety specifications are not exceeded.**

---

Set the **I/O** switch to the **O** position to power off the ventilator.

- The blue LED to the right of the **VENTILATION ON/OFF**  key turns off.
- The ventilator screen switches off.

### **Note:**

When the ventilator is completely stopped, but is still connected to the AC power source (the green AC POWER indicator is illuminated), the internal battery continues charging.

A continuous alarm condition will be activated if the ventilator power switch is turned off while ventilation is in progress. When the power switch is turned back on again, the ventilation will resume without having to press the VENTILATION ON/OFF button.

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## 8 Internal Battery



### WARNING

Even though the Puritan Bennett™ 560 Ventilator meets current safety standards, the internal Lithium-ion battery of the device exceeds the 100Wh threshold and is therefore considered to be Dangerous Goods (DG) Class 9 – Miscellaneous, when transported in commerce. As such, the Puritan Bennett™ 560 Ventilator and/or the associated Lithium-ion battery are subject to strict transport conditions under the Dangerous Goods Regulation for air transport (IATA: International Air Transport Association), International Maritime Dangerous Goods code for sea and the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) for Europe. Private individuals who transport the device are excluded from these regulations although for air transport some requirements apply. For air transport; the Puritan Bennett™ 560 Ventilator is permitted as checked-in or carry-on baggage. Two spare batteries per person may be taken on board as carry-on luggage only, with the prior approval of the airline. This classification and regulatory requirements may vary depending upon the country and mode of transport. Therefore it is recommended that users verify with the carrier / airline as to which measures to take before the voyage.

Ensure that the ventilator's internal battery is fully charged before connecting the ventilator to an external DC power source. Powering the ventilator using an external 12– 30 VDC power source (via the DC power cable) does not enable charging of its internal battery.

The maximum recommended shelf life of the internal battery is two (2) years. Do not use a battery that has been stored for two years prior to its first use.

Periodic recharging is important to help maximize useful life of the battery. Do not store the internal battery for extended periods, without recharging, as this may reduce the maximum life.

### 8.1 Battery Capacity

The reserve capacity offered by the internal battery depends on the level of ventilation parameters, the environmental conditions (primarily in terms of temperature) and the physiological characteristics of the patient.

With a fully charged battery at a normal room temperature of 25 °C ( $\pm 5$  °C), the ventilator can be expected to operate on internal battery power for the average durations shown in [Table 8-1](#).

Checking the battery charge level requires that the ventilator be running on battery power at the time of the battery check. To check the battery charge level, temporarily disconnect the ventilator from AC power (while in Stand By mode or while providing ventilation) and read the percent charge level displayed adjacent to the battery icon displayed at the top of the ventilator's display screen.

**Table 8-1.** Internal Battery Reserve Capacity

Displayed Values	Average Operating Time on Internal Battery Power <sup>a</sup>
Vt = 200 ml ( $\pm 5$ ml) PIP = 10 mbar ( $\pm 2$ mbar) Rtot = 20 bpm	11 hours (–10%)
Vt = 300ml ( $\pm 5$ ml) PIP = 20 mbar ( $\pm 2$ mbar) Rtot = 15 bpm	9 hours (–10%)

**Table 8-1.** Internal Battery Reserve Capacity (Continued)

Displayed Values	Average Operating Time on Internal Battery Power <sup>a</sup>
Vt = 500 ml ( $\pm$ 5 ml) PIP = 30 mbar ( $\pm$ 2 mbar) Rtot = 15 bpm	6.5 hours ( $\sim$ 10%)
Vt = 750 ml ( $\pm$ 5 ml) PIP = 45 mbar ( $\pm$ 2 mbar) Rtot = 20 bpm (Maximum Ventilation Parameters)	4.5 hours ( $\sim$ 10%)

a. Average durations shown are with a fully charged battery having less than 50 charge/recharge cycles.

## 8.2 Battery Operation





### WARNING

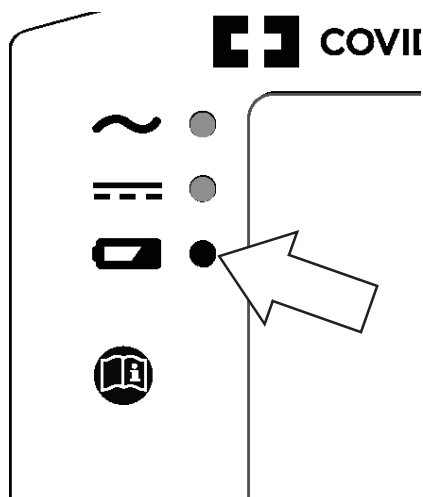
Before using the ventilator's internal battery, ensure that the battery is fully charged and that the charge holds. Back up ventilators or those in storage should be connected to an AC power source to protect the integrity of the battery.

### Note:

Buzzer and battery alarms may occur when the unit is first powered on after the internal battery has been completely drained. Connect to an AC power source and recycle power.

In the event of AC power interruption or disconnection of the external AC or DC power supply, the ventilator automatically switches to its internal battery and the following events occur:

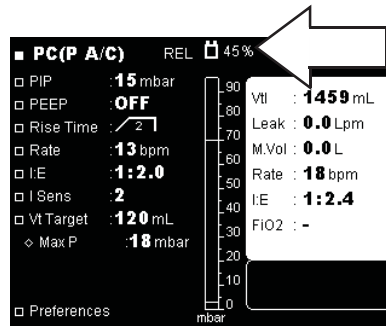
- The Battery  symbol is displayed at the top on the general information line.
- Battery reserve capacity is displayed on the right of the  symbol.
- The "INTERNAL BATTERY" indicator at the top left of the ventilator's front panel is continuously lit ([Figure 8-1](#)).



**Figure 8-1.** Internal Battery Indicator

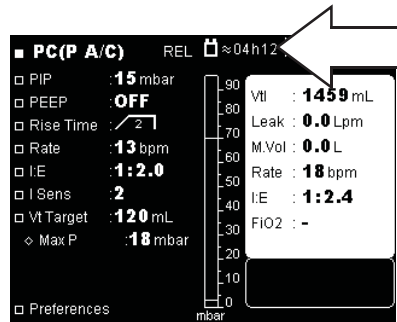
- A loss of external supply alarm is activated.

If ventilation is *stopped*, the internal battery reserve capacity is displayed as a percentage of battery charge. Refer to [Figure 8-2](#).



**Figure 8-2.** Battery Reserve Capacity as a Percentage

If the ventilator is *running*, the internal battery reserve is momentarily displayed as a percentage. Then, after the ventilator calculates the battery time remaining (which takes about two minutes, depending on the power consumption of the ventilator), the internal battery reserve is then displayed in hours and minutes (rounded to the nearest fifteen minutes). Refer to [Figure 8-3](#).



**Figure 8-3.** Battery Reserve Capacity in Hours and Minutes

The “LOW BATTERY” and “EMPTY BATTERY” alarms (refer to chapter 5, “Alarms and Troubleshooting”) are triggered when the internal battery reserve is reduced.



#### WARNING

**Due to its limited internal battery’s reserve capacity, the ventilator should only be operated on the internal battery when no other power source is available. Ensure that the internal battery never becomes fully discharged.**

**When the “LOW BATTERY” alarm is triggered, immediately connect the ventilator to an AC power supply to maintain ventilation and recharge the internal battery.**

From the time that an “EMPTY BATTERY” alarm is activated, if no external supply is connected to the ventilator, other alarms may be triggered due to insufficient supply voltage.

In the final discharge phase, the “EMPTY BATTERY” alarm will become continuous, and ventilation may be interrupted at any time during this phase.

#### Note:

The “EMPTY BATTERY” alarm symbol may disappear shortly before the ventilator completely stops, but it always triggers a final, continuous alarm.

## 8.3 Testing the Battery

Your ventilator continuously and automatically checks the state of the internal battery, even when the battery is not used as the main source of energy. The “BATTERY FAULT1” alarm is activated whenever a problem is detected in the battery or the charger.

However, on a monthly basis you should disconnect the ventilator from the external power supply to check the integrity of the connections linking the internal battery to other ventilator components.

## 8.4 Recharging the Battery

In the event that the battery charge level is considered insufficient, as per the reserve capacity display, recharge of the internal battery is necessary. In general, it is recommended that the ventilator be allowed to charge when the battery drops below 80%, and that the ventilator be recharged systematically after storage and before using it again.

### Note:

To avoid cycling and extend battery life while connected to an AC power source, the battery will not begin charging until it has dropped below an 85%-90% charge.

### To charge the internal battery, do the following:

Connect the ventilator to the AC power source.

- The “AC POWER” indicator illuminates (Figure 8-4, item 1).
- The “INTERNAL BATTERY” indicator flashes (Figure 8-4, item 2).

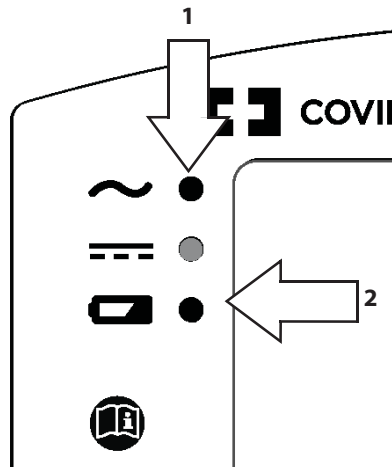


Figure 8-4. Power Indicators When Charging the Battery

When the battery charge is complete, the “INTERNAL BATTERY” indicator turns off.



### WARNING

**Even if the “INTERNAL BATTERY” indicator is off, charge of the battery may sometimes be incomplete regardless of charge time when the ambient temperature is above 40 °C (104 °F). This is due to the characteristics of the battery’s internal heat safety device.**

Although it is not necessary to start the ventilator to charge the battery, charging the battery during operation will increase the time required to fully charge the internal battery.

When recharging a depleted internal battery, it may be necessary to leave the ventilator on charge for up to six (6) hours if the ventilator is on standby and about 13 hours if ventilation is operating.

**WARNING**

Ensure that the ventilator's internal battery is fully charged before connecting the ventilator to an external DC power source. Powering the ventilator using an external 12–30 VDC power source (via the DC power cable) does not enable charging of its internal battery.

## 8.5 Storage

If the ventilator is to be stored for an extended period of time, it is not necessary to remove the battery. However, the ventilator should be stored in cool, dry, well-ventilated environment, as follows:

- Temperature: approximately 21 °C (70 °F)
- Humidity: less than 80% RH

**Note:**

When the device is in storage it should be recharged monthly to maximise battery life.

If the battery is stored for more than one month at a temperature greater than 21 °C (70 °F), or for more than one or two weeks at a temperature greater than 45 °C (113 °F), the reserve capacity of the battery may be affected. It will then be necessary to recharge the battery before using it again.

If the ventilator has been in storage for longer than 30 days connect it to an AC power source, turn on the unit by the I/O switch at the rear of the ventilator, and let it charge for 15 minutes prior to starting ventilation.

**Note:**

Fully charge the internal battery prior to disconnecting from AC Power source ("mains").

The battery should not be stored for more than two years, whatever the conditions.

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## 9 Cleaning



### WARNING

A patient treated by mechanical ventilation is highly vulnerable to the risks of infection. Dirty or contaminated equipment is a potential source of infection. Clean the ventilator and its accessories regularly and systematically before and after each use and following any maintenance procedure to reduce the risks of infection. The use of a bacterial filter at the ventilator's outlet—or both ports if a double-limb circuit is used—is highly recommended. Refer to chapter 9, “Cleaning”.

To reduce the risk of infection, wash your hands thoroughly before and after handling the ventilator or its accessories.

### 9.1 Cleaning the Ventilator

Clean all external panels and surfaces before and after each patient use and as often as necessary to keep the ventilator clean. You should clean the ventilator periodically, whenever it is soiled or dirty, before any maintenance operation, and before storing the ventilator.



### WARNING

Use all cleaning solutions and products with caution. Read and follow the instructions associated with the cleaning solutions you use to clean your ventilator. Use only those solutions listed in Table 9-1.

The ventilator should never be immersed in any liquid, and any liquid on the surface of the device should be wiped away immediately.

To avoid damage to the ventilator, in particular the batteries or electrical components, fluids must not be allowed to enter the device, particularly through the air inlet filter or the cooling apertures located in the side, rear, and bottom panels of the ventilator.

#### To clean the surface of the ventilator:

1. Dip a clean, soft cloth into a mixture of mild soap and water, or other approved cleaning solution. Refer to Table 9-1 for a list of approved cleaning solutions.
2. Squeeze the cloth thoroughly to remove excess liquid.
3. Lightly wipe the external casing of the ventilator, taking care not to allow excess moisture to enter any of the openings on the ventilator's surface. See the warning, above.
4. Dry the ventilator surface with a clean, soft, lint-free cloth.

**Table 9-1.** Approved Cleaning Solutions for Exterior Ventilator Surfaces

Description
Mild dishwashing detergent
70% isopropyl alcohol (rubbing alcohol)
10% chlorine bleach (90% tap water)

**Table 9-1.** Approved Cleaning Solutions for Exterior Ventilator Surfaces (Continued)

Description
Glutaraldehyde
Hospital disinfectant cleaners
Hydrogen peroxide
15% ammonia (85% tap water)
Ammonia-based household cleaners
Household cleaners

## 9.2 Cleaning the Accessories

Follow the accessory manufacturer's instructions for cleaning the ventilator's accessories and components, including the patient circuit.

---

**WARNING**

**After assembling, cleaning, or reassembling the patient circuit, and on a daily basis, inspect the hoses and other components to ensure that there are no cracks or leaks and that all connections are secure.**

**Never use a liquid cleaner inside the patient circuit, or on any component of a gas pathway. Clean the patient circuit only as specified by the manufacturer's instructions.**

---

## 9.3 Cleaning the Exhalation Block

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**WARNING**

**The exhalation block is intended for single use by a single patient ②. It may periodically be cleaned, but it cannot be disinfected or sterilised. To maintain good measurement quality when used continuously, clean the exhalation block periodically. The exhalation block should be changed every 4 months and cannot be reused with any other patient.**

**Ensure that the exhalation block is completely dried after cleaning and prior to use.**

---

The exhalation block can be removed easily from the device by first removing a captive screw, accessible through the bottom of the device (refer to section 6.7, "Exhalation Block," on page 6-12).

Whenever the exhalation block is removed or after installing a new one, you must calibrate the exhalation flow sensor. Refer to section 10.1, "Calibrating the Exhalation Flow Sensor," on page 10-1.

# 10 Routine Maintenance



## WARNING

On a **DAILY** basis, inspect the patient circuit to ensure that it shows no signs of damage, is properly connected, and is operating correctly without leakage.

**Do not attempt to open, repair or otherwise service the ventilator yourself. Doing so might endanger the patient, damage the ventilator, and/or void your warranty. Only personnel authorised and qualified by Covidien should repair, open or service the ventilator.**

## 10.1 Calibrating the Exhalation Flow Sensor

Each time the exhalation block or circuit is removed and reinstalled or after installing a new exhalation block, the exhalation flow sensor must be recalibrated before the using the ventilator. This process is automatic and does not require the use of a measurement device.

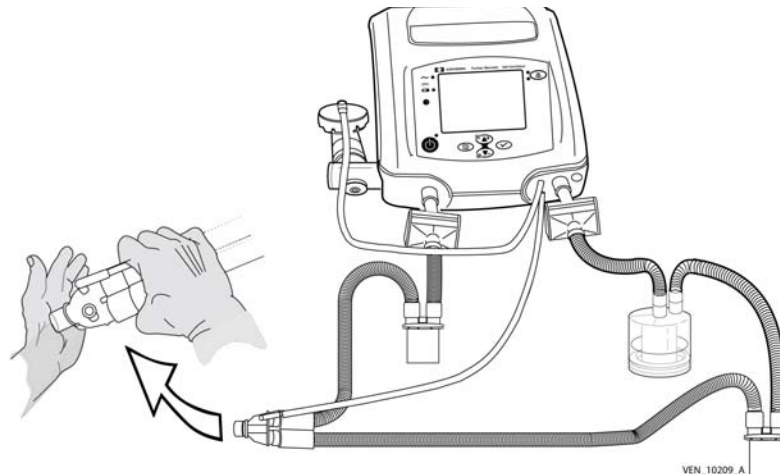
### Note:

Calibration may be done with either an adult or pediatric circuit; however, Pediatric YES/NO must be appropriately selected in the ventilator Preferences Menu.

### To calibrate the exhalation flow sensor:





(Refer to [Figure 10-1](#) as required)

1. Ensure the ventilator is on and in Standby mode.
2. Ensure the Locking Key is disabled (refer to section 7.9, "Unlocking the Control Panel," on page 7-26).



**Figure 10-1.** Blocking the Patient Wye (Double-Limb Circuit Shown)

3. Obstruct the patient wye's open connector using the fleshy portion of your palm to make a good seal as shown in [Figure 10-1](#).

4. Press the **MENU**  key to access the alarm settings menu—if this is not the menu currently displayed.
5. Press the **UP**  or **DOWN**  key to place the cursor on the VTE setup line.
6. Press the **ENTER**  key twice to access the Patient column (central column) of the VTE setup line.
  - “OFF” flashes in the central column.
  - A zoom of “OFF” is displayed, flashing, in the window on the right.
  - The message “Calibration Exp. Flow?” is displayed in the window on the right.


P A/C			
	Min	Current	Max
VTI mL	300	-	2000
± VTE mL	300	OFF	1000
Rtot bpm	-	-	OFF
FiO2 %	OFF	21	OFF
Alarms Logs			

**Figure 10-2.** Calibrating the Exhalation Flow Sensor (1)

7. Press the **UP**  or **DOWN**  key. “YES” is displayed instead of “OFF”.

P A/C			
	Min	Current	Max
VTI mL	300	-	2000
± VTE mL	300	YES	1000
Rtot bpm	-	-	OFF
FiO2 %	OFF	-	OFF
Alarms Logs			

**Figure 10-3.** Calibrating the Exhalation Flow Sensor (2)

8. Press the **ENTER**  key to start calibration.
  - The message “... Exp. calib. Processing ...” is displayed in the window on the right, while calibration is in progress.

P A/C			
	Min	Current	Max
VTI mL	300	-	2000
± VTE mL	300	...	1000
Rtot bpm	-	-	OFF
FiO2 %	OFF	21	OFF
Alarms Logs			

**Figure 10-4.** Calibrating the Exhalation Flow Sensor (3)

- The ventilator adjusts the speed of the blower to reach the initial calibration point.

- A short beep sounds to confirm that the first point has been adjusted.
- The ventilator automatically increases and adjusts the speed of the blower to reach the next calibration point.
- A short beep sounds to confirm that the second calibration point has been adjusted.
- This process continues until all eight calibration points have been adjusted.

**Note:**

The exhalation flow sensor calibration procedure, once initiated, must run to its conclusion.

No message is displayed when the ventilator passes calibration; a message only is displayed if the calibration has failed.

In the event of calibration errors, the following events occur:

- The ventilator sounds a long beep at each point that fails calibration.
- An alarm is activated, and the message “CALIBRATION FAIL” is displayed.
- The ventilator takes the previously saved value as the default and automatically switches to the next calibration point

If a “CALIBRATION FAIL” alarm occurs, do the following:

1. Ensure the exhalation block is properly seated.
2. Ensure an approved circuit is in use (refer to circuit documentation).
3. Check the integrity of the circuit and all connections.
4. Ensure the correct circuit type is selected in the ventilator preferences.
5. Repeat the calibration procedure keeping a tight seal over the end of the circuit during calibration.

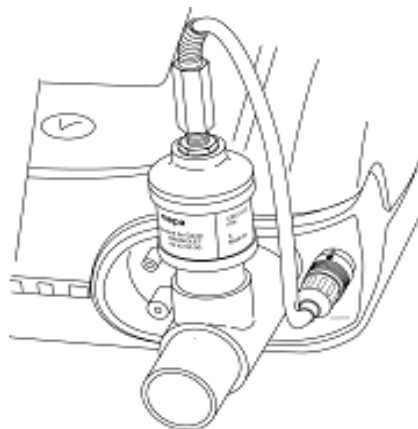
For more information on the “CALIBRATION FAIL” alarm, refer to section 5.8, “Troubleshooting”.

## 10.2 Calibrating the FiO<sub>2</sub> sensor





Each time the FiO<sub>2</sub> sensor is removed and reinstalled, and on a weekly basis, the FiO<sub>2</sub> sensor must be recalibrated before using the ventilator. This process does not require the use of a measurement device.

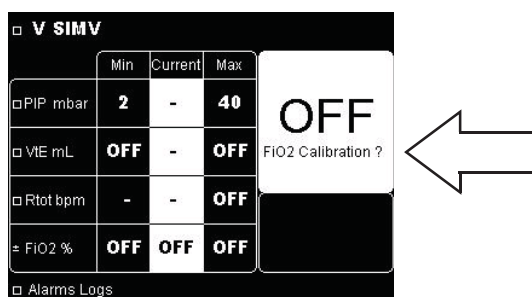
**To calibrate the FiO<sub>2</sub> sensor:**

(refer to [Figure 10-5](#) if required)



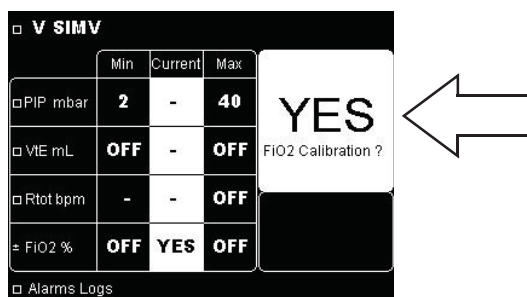
**Figure 10-5.** Calibrating the FiO<sub>2</sub> sensor (1)

1. Ensure the ventilator is on and in Standby mode.
2. Ensure the Locking Key is disabled (refer to section 7.9, "Unlocking the Control Panel," on page 7-26).
3. Connect the FiO<sub>2</sub> sensor to the ventilator (Refer to chapter 6.8.3, "Connecting the FIO2 sensor").
4. Press the **MENU**  key to access the alarm settings menu—if this is not the menu currently displayed.
5. Press the UP  or DOWN  key to place the cursor on the FiO<sub>2</sub> setup line.
6. Press the ENTER  key twice to access the Patient column (central column) of the FiO<sub>2</sub> setup line.
  - "OFF" flashes in the central column
  - A zoom of "OFF" is displayed flashing in the window on the right
  - The message "FIO2 Calibration?" is displayed in the window on the right.



**Figure 10-6.** Calibrating the FiO2 Sensor (2)

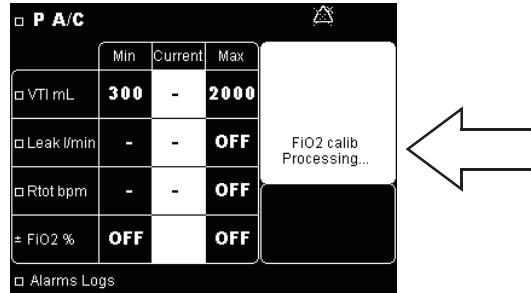
7. Press the UP  or DOWN  key. "YES" is displayed instead of "OFF".




**Figure 10-7.** Calibrating the FiO2 Sensor (3)

8. Press the ENTER  key to start calibration.

- The message “FIO2 calib. Processing...” is displayed in the window on the right while calibration is in process.



**Figure 10-8.** Calibrating the FiO2 Sensor (4)

- A short beep sounds to confirm that the FiO<sub>2</sub> sensor has been calibrated.
9. Press the ENTER  key to exit the FiO<sub>2</sub> setup line.

**Note:**

The FiO<sub>2</sub> sensor calibration procedure, once initiated, must run to its conclusion.

In the event of calibration errors the following events occur:

- An alarm is activated and the message “FIO2 CALIBRATION FAIL” is displayed.
- The ventilator takes the previously saved value as the default.

For more information on the “FIO2 CALIBRATION FAIL” alarm (Refer to chapter 5.8, “Troubleshooting”

## 10.3 Replacing the Air Inlet Filter



**WARNING**

**Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. If necessary, replace the filter before the recommended replacement period is over. This is particularly important when the ventilator is installed on a wheelchair, because environmental conditions may cause the filter to become dirty more rapidly.**

**Failing to replace a dirty air inlet filter, or operating the ventilator without a filter, may cause serious damage to the ventilator.**

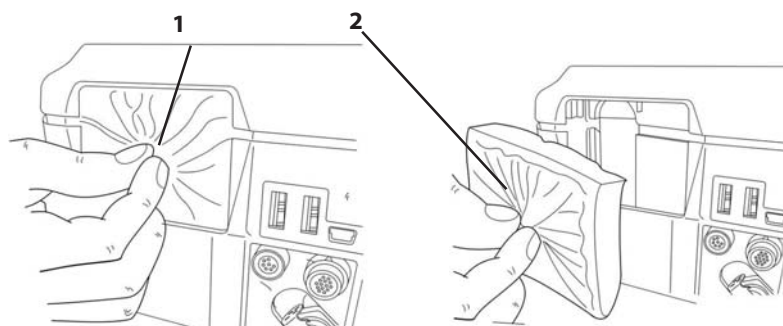
**The air inlet filter is not reusable; do not attempt to wash, clean, or reuse it.**

If the ventilator is used indoors, the condition of the air inlet filter should be checked monthly. If the ventilator is used outdoors or in a dusty environment, the air inlet filter should be checked weekly and replaced as necessary.

**To replace the air inlet filter:**

- Hold the filter between your fingers (see [Figure 10-9](#), item 1).
- Remove the filter ([Figure 10-9](#), item 2) and discard it.

3. Place the new filter in the device, while ensuring that:
  - a. The fine particle side of the filter faces *outwards*, away from the ventilator.
  - b. The filter is properly installed in its housing. Proper installation of the filter prevents particles from entering the device.



**Figure 10-9.** Replacing the Air Inlet filter

## 10.4 Recommended Schedule of Maintenance

### Consumables and Replacement Intervals

When used under normal circumstances - a relatively dust-free atmosphere, and without damage to the device and its components (shocks, cracks, significant dirt) - the intervals for replacing the ventilator's consumable elements are as follows:

**Table 10-1.** Consumables and Replacement Intervals

Elements	Recommended Replacement Intervals
Air Inlet Filter (Foam + Fine Particle)	Once a month or more often, depending on the extent of soiling
Inspired Bacteria Filter	See manufacturer's recommendation
Patient Circuit	See manufacturer's recommendation Single use Single patient ②
FiO <sub>2</sub> Sensor	14 to 18 months or more often in case of persistent calibration failure
Exhalation Block	4 months(*) (and for each new patient)

#### Note:

For a list of parts and accessories, refer to [Appendix H, "Parts and Accessories"](#) or contact your service representative or consult [www.puritanbennett.com](http://www.puritanbennett.com).

\* The exhalation block replacement frequency may be 3 months (\*\*) for patients ventilated by tracheotomy > 12 hours / day. The replacement frequency may be extended to 6 months for patients ventilated < 12hours / day depending on the frequency of technician visits

\*\* This minimum replacement period is based on bench test validation performed under 24/24 continuous ventilation and active humidification conditions over a period of 3 months. (Test report N°08DE265). Test report results show that no condensation or drops of water that would affect flow measurement were found in the exhalation block or the Piezzo valve.

**Note:**

For all additional accessories not necessarily considered as consumables consult the manufacturer's recommendations.

To prevent any risk of cross contamination we recommend the use of STERIVENT filters (Ref: 351/5856 or equivalent) to protect the patient outlet port and the exhalation block port.

---

 **WARNING**

**Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. Replace it when necessary—even before the recommended replacement period has elapsed, and particularly when the ventilator is installed on the wheelchair. Environmental conditions may cause the filter to become dirty more rapidly.**

**The exhalation block is intended for single use by a single patient ② . It may periodically be cleaned, but it cannot be disinfected or sterilised. To maintain good measurement quality when used continuously, clean the exhalation block periodically (refer to section 9.3, “Cleaning the Exhalation Block,” on page 9-2). The exhalation block should be changed every 4 months and cannot be reused with any other patient.**

---

Failure to observe these recommendations may result in a loss of performance, excessive overheating, a loss of certain functions and, in the long term, compromise the longevity of the ventilator.

**Maintenance of the Internal Battery**

The internal battery does not need to be removed to verify its correct operation.

**Periodic Test of the Internal Battery**

Your ventilator continuously and automatically checks the state of the internal battery, even when the internal battery is not used as the main power source.

However, the battery charge status should be checked MONTHLY by disconnecting the ventilator from external power supplies (refer to section 8.2, “Battery Operation”). Such a test is *imperative* after opening the ventilator or after a prolonged period of non-use (one month or more), in order to ensure the correct operation of internal connections linking the battery to other components.

---

 **WARNING**

**The maximum recommended shelf life of the internal battery is two (2) years. Do not use a battery that has been stored for two years prior to its first use.**

**Periodic recharging is important to help maximize useful life of the battery. Do not store the internal battery for extended periods, without recharging, as this may reduce the maximum life.**

---

**Replacement of the Internal Battery**

The internal battery should be replaced when the battery capacity drops below 3450 mAh. Keep in mind that, for environmental protection, the ventilator and its components—including its internal battery—cannot be disposed of with household waste. You must submit the ventilator and its components for suitable selective collection and possible recycling and observe all applicable regulations.

**Note:**

As the total number of battery charge/discharge cycles approaches 300, a drop in potential of as much as 20% may be detected.

## 10.5 Service Assistance

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 **WARNING**

**If a problem with the ventilator is suspected, FIRST CHECK THAT THE PATIENT IS NOT IN DANGER. If necessary, remove the patient from the ventilator and provide an alternative means of ventilation.**

**Do not attempt to open, repair or otherwise service the ventilator yourself. Doing so might endanger the patient, damage the ventilator, and/or void your warranty. Only qualified service personnel should open, repair or service the ventilator.**

---

In the event of a problem with the ventilator, refer to chapter 5, [“Alarms and Troubleshooting”](#). If you cannot determine the cause of the problem, contact your equipment supplier or Covidien.

For more information and local Covidien Technical Service Contact details, refer to chapter , “Technical Support” in Preface chapter.

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# A Patient/Caregiver Checklist

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## What the Patient and Caregiver Must Understand

Table A-1 presents a summary of the topics that patients and caregivers must understand in order to use the ventilator successfully. Some topics may not apply to some patients, while other patients may require additional information.

## The Clinician's Responsibility

It is the responsibility of the clinician or clinical educator to ensure that both the patient and the caregiver fully understand the topics listed below.

**Table A-1.** Patient/Caregiver Checklist

List of Topics	References
<input type="checkbox"/> Need for ventilation	Clinician
<input type="checkbox"/> Intended use of the ventilator	Chapter 2, "Ventilator Overview"
<input type="checkbox"/> The principles of operation for the ventilator	Appendix C, "Theory of Operation"
<input type="checkbox"/> Supplies required for ventilation, and their sources	Clinician; Appendix G, "Unpacking and Preparation"; Appendix H, "Parts and Accessories"
<input type="checkbox"/> Schedule for ventilation	Clinician
<input type="checkbox"/> How and why to monitor the patient's condition.	Clinician
<input type="checkbox"/> The importance of coordinating care for the patient.	Clinician
<input type="checkbox"/> Resources for respite care.	Clinician
<input type="checkbox"/> Choices about future care.	Clinician
<input type="checkbox"/> The purpose of advanced directives.	Clinician
<input type="checkbox"/> How to check the patient's vital signs.	Clinician
<input type="checkbox"/> The significance of the patient's ease of breathing.	Clinician
<input type="checkbox"/> What to note about the patient's skin, mucus membranes, and secretions, and their significance.	Clinician
<input type="checkbox"/> How to recognise the signs of infection, and how to respond.	Clinician
<input type="checkbox"/> Whom to contact for medical emergencies, equipment emergencies, or power emergencies.	Clinician; section 5.8, "Troubleshooting"; section 10.5, "Service Assistance"
<input type="checkbox"/> Equipment and phone numbers to have available in cases of emergency.	Clinician; Section 10.5, "Service Assistance"

**Table A-1.** Patient/Caregiver Checklist (Continued)

List of Topics	References
<input type="checkbox"/> How to contact other resources for assistance (health aides, attendants, therapists, and so on).	Clinician
<input type="checkbox"/> The importance of routine medical appointments and medical testing.	Clinician
<input type="checkbox"/> Power sources for the ventilator and how to connect them	Section 6.2, "Connecting to External AC Power" and section 6.3, "Connecting to an External DC Power Source"
<input type="checkbox"/> The meaning of keys and buttons.	Section 2.7, "Control Panel"
<input type="checkbox"/> The meaning of symbols and markings.	Section 1.3, "Symbols and Markings"
<input type="checkbox"/> How to connect the patient to the ventilator via the patient breathing circuit.	Section 6.4, "Patient Circuit"
<input type="checkbox"/> The parts and purpose of the breathing circuit.	Chapter 6, "Installation and Assembly"
<input type="checkbox"/> How and when to inspect, clean, and replace the patient circuit.	Chapter 1, "Safety Information"; Chapter 9, "Cleaning"; Section 10.4, "Recommended Schedule of Maintenance"
<input type="checkbox"/> How to recognise and respond to problems with the breathing circuit.	Chapter 5, "Alarms and Troubleshooting"
<input type="checkbox"/> The parts and purpose of the nasal interface or mask.	Clinician or manufacturer's instructions for use.
<input type="checkbox"/> Care of the nasal interface or mask.	Clinician or manufacturer's instructions for use.
<input type="checkbox"/> How to recognise and respond to problems with the nasal interface or mask.	Clinician or manufacturer's instructions for use.
<input type="checkbox"/> How to install the humidifier.	Section 6.6, "Humidifier"
<input type="checkbox"/> How to perform alarms tests, and how to respond if the alarms tests fail.	Appendix F, "Alarms Tests"; Chapter 5, "Alarms and Troubleshooting"
<input type="checkbox"/> How to change the Exhalation Block.	Section 6.7, "Exhalation Block"
<input type="checkbox"/> Replacement interval for outlet filters (per the filter manufacturer's instructions).	Section 10.4, "Recommended Schedule of Maintenance"
<input type="checkbox"/> Setting ventilation parameters and the importance of each	Section 3, "Operating Parameters"
<input type="checkbox"/> Ventilator alarm settings; understanding the purpose and function of each.	Section 5.7, "Overview of Alarms"
<input type="checkbox"/> Recognising alarm priority level	Section 5.1, "Alarm Level of Priority"
<input type="checkbox"/> What to do in case of ventilator alarms and problems	Section 5, "Alarms and Troubleshooting"
<input type="checkbox"/> What to do if the ventilator alarms inappropriately.	Section 5.8, "Troubleshooting"
<input type="checkbox"/> The oxygen setting, and why it is required.	Clinician

**Table A-1.** Patient/Caregiver Checklist (Continued)

List of Topics	References
<input type="checkbox"/> How to connect the oxygen source to the ventilator	Clinician; section 6.8, "Oxygen"
<input type="checkbox"/> How to determine the quantity of oxygen being delivered, and how to adjust the quantity.	Clinician; section 6.8, "Oxygen"
<input type="checkbox"/> Safety rules for the use of oxygen.	Chapter 1, "Safety Information"; section 6.8, "Oxygen"
<input type="checkbox"/> How to connect the FIO2 sensor to the ventilator	Clinician; section 6.8, "Oxygen"
<input type="checkbox"/> How to recognise and respond to problems with the oxygen supply.	Clinician
<input type="checkbox"/> How to respond to dyspnea	Clinician
<input type="checkbox"/> Techniques to prevent aspiration of vomit.	Clinician

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## B Specifications

### B.1 Physical

**Table B-1.** Physical Description (Excluding Accessories)

<b>Ventilator Weight</b>	9.9 lb. (4.5 kg)
<b>Ventilator Dimensions</b>	9.25 in wide x 12.40 in deep x 6.0 in high (235 mm wide x 315 mm deep x 154 mm high)
<b>Connectors</b>	Inspiratory limb connector: ISO 22 mm (OD) conical Exhalation limb connector (on exhalation block): ISO 22 mm (ID) conical Oxygen inlet: Female Connector with valve
<b>Device airway volume</b>	2000 ml
<b>Breathing circuit volume</b>	
• Adult, dual limb	1150 ml
• Pediatric, dual limb	670 ml
• Adult, single limb	550 ml
• Pediatric, single limb	300 ml
<b>Air Inlet Filter</b>	Dimensions: 70 mm long x 60 mm wide Composition: Polypropylene fiber electrostatic filter material, which is laminated onto polyurethane open-celled foam. Efficiency: 99.54% at 24 lpm (filtering microbes 2.5 µm to 3 µm)
<b>Inspiratory Bacteria Filter Requirement</b>	Maximum allowable flow resistance: 4mbar at 60 lpm

### B.2 Electrical

**Table B-2.** AC Electrical Supply

Voltage	Frequency	Consumption
100 VAC to 240 VAC	50 Hz / 60 Hz	180 VA max
12 VDC	NA	8.3 A
30 VDC	NA	3.3 A

**Table B-3.** Internal Lithium Ion Battery

Voltage	25.2 VDC
Full-load capacity	4.8 Ah
Ampere-hour rating	On standby: 1.5 Ah
	During ventilation: 0.5 Ah
Watt hour rating	124Wh to 126Wh

**Table B-3.** Internal Lithium Ion Battery (Continued)

Charging current <ul style="list-style-type: none"> <li>Standby mode</li> <li>Ventilation mode</li> </ul>	1.5 A/hr. (duration: < 6 hr.) 0.5 A/hr. (duration: < 13 hr.)
Average operating time at 25 °C (± 5 °C) with a fully charged battery (having less than 50 charge/discharge cycles) at the following displayed values: Vt = 200 ml (± 5 ml), PIP = 10 mbar (± 2 mbar), Rtot = 20 bpm      11 hr. (–10%) Vt = 300 ml (± 5 ml), PIP = 20 mbar (± 2 mbar), Rtot = 15 bpm      9 hr. (–10%) Vt = 500 ml (± 5 ml), PIP = 30 mbar (± 2 mbar), Rtot = 15 bpm      6.5 hr. (–10%) Vt = 750 ml (± 5 ml), PIP = 45 mbar (± 2 mbar), Rtot = 20 bpm      4.5 hr. (–10%) (maximum settings)	

**Table B-4.** Remote Alarm

**Remote Alarm Port:**

Also known as the Nurse's Call port, it provides for remote alerts of ventilator alarm conditions.

An example of a setting that requires such a feature is when the ventilator is used in an isolation room.

The ventilator signals an alarm using a normally open (NO) or a normally closed (NC) signal.

A remote alarm is activated when an alarm condition occurs, unless either of the following is true:

- Audio paused function is active
- Ventilator power switch is turned off

The remote alarm port is an 8-pin female connector. Allowable current is 100 mA at 24 VDC (maximum).

Nurse call pin-out (view from back of ventilator)

Pin	Signal	Remote Alarm Wire color
1	relay common	black
2	normally open (NO)	brown
3	normally closed (NC)	orange
4	remote supply - (not used)	
5	RX Signal (not used)	
6	TX Signal (not used)	
7	remote supply + (not used)	

## B.3 Indicators and Alarms

**Table B-5.** Power Indicators

Ventilation ON/OFF	AC power	DC power	
<ul style="list-style-type: none"> <li>Blue in standby mode</li> <li>Not lit if ventilation is in progress.</li> </ul>	Green	Green	<ul style="list-style-type: none"> <li>Flashing if the battery charge is in progress.</li> <li>Continuously lit if the ventilator is powered by the internal battery.</li> </ul>

**Table B-6.** Alarm Indicators

High Priority	Medium Priority
Red flashing LED	Yellow flashing LED

**Table B-7.** Audio Alarms

Audio Paused	Alarm Volume
60 s $\pm$ 1 s	65 to 85 dBA $\pm$ 10% at 1 meter

## B.4 Performance

### B.4.1 Specifications

**Table B-8.** Performance Parameter Specifications and Tolerances

Settings	Range	Tolerances
Volume	50 to 2000 ml	$\pm$ (10 ml + 10%)
Pressure	5 to 55 mbar	$\pm$ (1 mbar + 10%)
Time	0.3 to 6.0 s	$\pm$ 10%
Rate	1 to 60 bpm	$\pm$ 1 bpm
Inspiratory Sensitivity	1 to 5	N/A
Exhalation Sensitivity	5 to 95%	N/A
Vt Sigh	Vt x1 to Vt x 2	$\pm$ (20ml + 20%)
I:E	1:4 to 1:1	$\pm$ 50 ms or 10%, whichever is greater
I/T	20% to 50%	$\pm$ 50 ms or 10%, whichever is greater

## B.5 Monitored Parameters

**Table B-9.** Monitored Parameter Specifications and Tolerances

Ventilator Parameters	Range	Tolerances
Peak Inspiratory Pressure (PIP)	0 to 99 mbar	$\pm$ (2 mbar + 8%)
Positive End Expiratory Pressure (PEEP) <sup>a</sup>	0 to 99 mbar	$\pm$ (2 mbar + 8%)
Inspiratory Tidal Volume (VTI)	0 to 9999 ml	$\pm$ (10 ml + 10%VTI)*Rate
Exhalation Tidal Volume (VTE)	20 to 9999 ml	$\pm$ (10 ml + 10%VTE)*VTE
Total Breath Rate (Rtot)	0 to 99 bpm	$\pm$ 1 bpm

**Table B-9.** Monitored Parameter Specifications and Tolerances (Continued)

Ventilator Parameters	Range	Tolerances
I:E Ratio (I:E)	9.9:1 to 1:9.9	± 50 ms or 10%, whichever is greater
I/T Ratio (I/T)	0 to 100%	± 50 ms or 10%, whichever is greater
Inspiratory Time (I Time)	0 to 9.9 s	± 100 ms
Exhalation Time (E Time)	0 to 59.9 s	± 100 ms
Inspiratory Minute Volume (Min VI)	0 to 99.9 l	+/- (10ml + 10%)
Vt Sigh	Vt x1 to Vt x 2	± (20ml + 20%)
FiO <sub>2</sub>	0 to 99%	± (2.5% + 2.5% FiO <sub>2</sub> )
Leak	0 to 200 lpm	± (3 lpm + 20%)
Apnea Index (AI)	0 to 99 ev/h	± 1 ev/h
Apnea Time	0 to 999 s	± 1 s
% Spontaneous (Spont)	0 to 100%	± 1 %

a. The PB560 does not have the capability to reduce pressure below the PEEP pressure during the exhalation phase.

## B.6 Range, Resolution, and Accuracy

Table B-10 lists the ranges, resolutions, and accuracies for ventilator settings, alarm settings, and patient data.

**Table B-10.** Ventilator Range, Resolution, and Accuracy

Ventilator Settings	Range, Resolution, and Accuracy
Mode	Range: V A/C, P A/C, V SIMV, P SIMV, PSV, CPAP Resolution: N/A Accuracy: N/A Default value: P A/C
Tidal volume (Vt)	Range: 50 mL to 2000 mL Resolution: 10 mL Accuracy: $\pm (10 \text{ mL} + 10\%)$ of setting Default value: 500 mL Depends on: Insp time, R-Rate in V SIMV and P SIMV Depends on: Rate and I:E (I/T) in V A/C
Peak Inspiratory Pressure (PIP)	Range: 5 mbar to 55 mbar in valve configuration Range: 5 mbar to 30 mbar in leak configuration Resolution: 1 mbar Accuracy: $\pm (1 \text{ mbar} + 10\%)$ of P Control + PEEP setting Default value: 15 mbar Depends on PEEP when Relative Pressure is set to YES
Pressure control (P Control)	Range: 5 mbar to 55 mbar in valve configuration Range: 5 mbar to 30 mbar in leak configuration Resolution: 1 mbar Accuracy: $\pm (1 \text{ mbar} + 10\%)$ of P Control + PEEP setting Default value: 15 mbar Depends on PEEP when Relative Pressure is set to YES
Pressure support (P Support)	Range: OFF or 5 mbar to 55 mbar in valve configuration Range: 5 mbar to 30 mbar in leak in valve configuration Resolution: 1 mbar Accuracy: $\pm (1 \text{ mbar} + 10\%)$ of P Support + PEEP setting Default value: 15 mbar Depends on PEEP when Relative Pressure is set to YES
I:E Ratio (I:E)	Range: from 1:1 to 1:4 Resolution: 1/0.1 s Accuracy: $\pm 50 \text{ ms}$ or 10%, whichever is greater Default value: 1/2
I/T Ratio (I/T)	Range: 20% to 50% Resolution: 1% Accuracy: $\pm 50 \text{ ms}$ or 10%, whichever is greater Default value: 33%

**Table B-10.** Ventilator Range, Resolution, and Accuracy (Continued)

Ventilator Settings	Range, Resolution, and Accuracy
Inspiratory time (Insp Time)	Range: 0.3 s to 2.4 s Resolution: 0.1 s Accuracy: $\pm 50$ ms or 10%, whichever is greater Default value: 1.5 s Depends on: R-Rate, Vt in V SIMV mode Depends on: R-Rate in P SIMV mode
Respiratory rate (R-Rate)	Range: 5 bpm to 60 bpm in V A/C and P A/C modes 1 bpm to 40 bpm in P SIMV and V SIMV modes Resolution: 1 bpm Accuracy: $\pm 1$ bpm Default value: 13 Depends on: Insp Time and Vt in V SIMV mode Depends on: Insp Time in P SIMV modes Depends on: Vt in V A/C mode
Inspiratory sensitivity (I Sens)	Range: 1P-5 Resolution: 1 Accuracy: NA Default value: 2 in CPAP, I Sens is set to 2 and is not adjustable
Exhalation sensitivity (E Sens)	Range: 5% to 95% of peak flow Resolution: 5% Accuracy: $\pm$ (4 lpm + 10%) of target exhalation flow based on E Sens within 50ms Default value: 25% In CPAP, E Sens is fixed at 25% and is not adjustable.
Ramp (Flow Pattern)	Range: Square (SQ), descending ramp (D), sinusoidal (S) Resolution: N/A Default value: Descending ramp (D) In V SIMV, flow pattern is set to square and is not adjustable
PEEP	Range: OFF (0.5 mbar) to 20 mbar Resolution: 1 mbar Accuracy: $\pm$ (1 mbar + 10%) mbar Default value: OFF Depends on: PIP in P A/C and PSV modes when Relative Pressure is set to YES Depends on: P Support and P Control in P SIMV mode when Relative Pressure is set to YES Depends on: P Support in V SIMV mode when Relative Pressure is set to YES
Rise time	Range: 1-4 Resolution: 1 Default value: 2 Depends on: Insp time

**Table B-10.** Ventilator Range, Resolution, and Accuracy (Continued)

Ventilator Settings	Range, Resolution, and Accuracy
Backup rate	Range: OFF or 5-40 bpm Resolution: 1 bpm Default value: 13 Depends on: Min I time In P SIMV and V SIMV, Backup rate = Max (8, R-Rate)
Apnea time	Range: AUTO or 1-60 s Resolution: 1 s Default value: AUTO Depends on: Backup R In PSV, Apnea time: AUTO = 60/Backup R In V SIMV or P SIMV, Apnea Time: AUTO = 12 In CPAP, Apnea Time: AUTO = 30
Minimum Inspired Tidal Volume (Min VTI)	Range: 30 mL to 1990mL Resolution: 10 mL Default value: 300 Depends on: Max VTI
Maximum Inspired Tidal Volume (Max VTI)	Range: 80 mL to 3000 mL Resolution: 10 mL Default value: 2000 mL Depends on: Min VTI
Minimum Exhaled Tidal Volume (Min VTE)	Range: 30 mL to 1990 mL Resolution: 10 mL Default value: 300 Depends on: Max VTE
Maximum Exhaled Tidal Volume (Max VTE)	Range: 80 mL to 3000 mL Resolution: 10 mL Default value: 1000 Depends on: Min VTE
Maximum Respiratory Rate (Max Rtot)	Range: 10 bpm to 70 bpm Resolution: 1 bpm Default value: OFF Depends on: R-Rate
Minimum Peak Inspiratory Pressure (Min PIP)	Range: PIP- 20% (not adjustable in pressure breath) Range: 2-52 in volume breath) Resolution: N/A
Maximum Peak Inspiratory Pressure (Max PIP)	Range: PIP+ 20 % (not adjustable in pressure breath) Range: 8-60 in Volume breath) Resolution: N/A
Minimum inspiratory time (Min I time)	Range: 0.1 to 3s Resolution: 0.1 s Default value: AUTO (Rise time + 300 ms) Depends on: Max I Time, Backup R, Rise time

**Table B-10.** Ventilator Range, Resolution, and Accuracy (Continued)

Ventilator Settings	Range, Resolution, and Accuracy
Maximum inspiratory time (Max I time)	Range: 0.8 to 3 s Resolution: 0.1 s Default value: AUTO {Min [3 s; (30/R-Rate)]} Depends on: Min I Time, R-Rate
Minimum Fraction of Inspired Oxygen (Min FiO <sub>2</sub> )	Range: 18 to 90 % Resolution: 1 % Default value: 18 Depends on: Max FiO <sub>2</sub>
Maximum Fraction of Inspired Oxygen (Max FiO <sub>2</sub> )	Range: 30 to 100 % Resolution: 1 % Default value: 100 Depends on: Min FiO <sub>2</sub>

## B.7 Environmental

The following environmental conditions shall be observed:

**Table B-11.** Environmental Conditions for Storage or Transport

Temperature	Humidity -40° C to +70° C (-40 °F to 158 °F)	Atmospheric pressure	Altitude
-40° C to +70° C (-40°F to +158 °F)	10% to 95% RH	500 hPa to 1060 hPa (7.2 psi to 15.4 psi)	-152 m to 3964 m (500ft to 13,000 ft)

**Table B-12.** Environmental Conditions for Operation

Temperature	Humidity	Atmospheric pressure	Altitude
+5°C to 40°C (+41 °F to 104 °F)	10% to 95% RH	600 hPa to 1100 hPa (8.7 psi to 16.0 psi)	-152 m to 3964 m (-500 ft to 13,000 ft)

Under extreme conditions of use that are beyond the recommendations above but within the limits of a supply voltage of -20%, compared to the nominal temperature or the combination of a temperature of 45 °C (113 °F) and humidity of 75% RH, the ventilator should not malfunction nor endanger the user. However, operating the device for prolonged periods or repeatedly under such extreme conditions could result in premature aging of components and more frequent maintenance.

## B.8 USB

**Table B-13.** USB Memory Device Specifications

Characteristics	Supported formats
USB compatibility	USB flash memory USB 2.0 or USB 1.1
Memory file format	USB 32 bit format (sector size: 512 - 2,048 bytes)
Number of files	Maximum 999
USB size	128Mo to 4Gb

**Table B-14.** Data Transfer Characteristics

Ventilator data description	Capacity
Trends capacity	86Mb
Events capacity	512 Ko or 5,500 events
Monitorings capacity	42 Mo/ 48 hours

## B.9 Pneumatic

**Table B-15.** Airway Resistances

Inspiratory	Exhalation
1.0 mbar at 30 lpm flow	0.5 mbar at 30 lpm
3.7 mbar at 60 lpm flow	1.1 mbar at 60 lpm

**Table B-16.** Patient Circuit Resistances<sup>a</sup>

Adult Double Limb	Pediatric Double Limb
≤ 2 mbar at 60 lpm flow <sup>b</sup>	≤ 2 mbar at 30 lpm flow

a. Includes exhalation valve

b. Values obtained from the manufacturer's directions for use.

**Table B-17.** Air Inlet Resistance (Filter)

0.057 mbar (0.0057 kPa) <sup>a</sup> at 24 lpm flow
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a. All testing conducted on 3-inch diameter test piece

**Table B-18.** Oxygen Inlet Specifications

Maximum pressure	Maximum flow
50 kPa (7.25 psi)	15 lpm

**Table B-19.** Performance Specifications

Working pressure	Sound pressure level	Maximum pressure limit	Internal compliance (ventilator)	Inspiratory triggering response time (Ttr)
5 mbar – 55 mbar	30 dBA (per NF EN ISO 17510-1 test conditions)	60 mbar	.0001 l/mbar	100 ms

## B.10 Manufacturer's Declaration

The following tables, [Table B-20](#) through [Table B-23](#), contain the manufacturer's declarations for the ventilator's electromagnetic emissions, electromagnetic immunity, and recommended separation distances between the ventilator and portable and mobile RF communications equipment, as well as a list of compliant cables.



**WARNING**

**Portable and mobile RF communications equipment can affect the performance of the Puritan Bennett™ 560 Ventilator. Install and use this device according to the information contained in this manual.**

**The ventilator should not be used adjacent to or stacked with other equipment, except as specified in this manual. If adjacent or stacked use is necessary, the ventilator should be observed to verify normal operation in the configurations in which it will be used.**


**Table B-20.** Electromagnetic Emissions

The Puritan Bennett™ 560 Ventilator is intended for use in the electromagnetic environment specified below. The customer or the user of the ventilator should assure that it is used in such an environment.		
RF emissions CISPR 11 / EN 55011	Group 1	The ventilator uses RF energy only for its internal functions. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11 / EN 55011	Class B	The ventilator is suitable for use in all establishments including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC / EN 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC / EN 61000-3-3	Complies	

**Table B-21.** Electromagnetic Immunity

The ventilator is intended for use in the electromagnetic environment specified below. The customer or the user of the ventilator should ensure that it is used in such an environment.			
Immunity Test	IEC / EN 60601 Test Level	Compliance Level	Electromagnetic Environment–Guidance
Electrostatic discharge (ESD) IEC / EN 61000-4-2	± 6 kV contact  ± 8 kV air	± 6 kV contact  ± 8 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC / EN 61000-4-4	± 2 kV for power supply lines  ± 1 kV for input/output lines	± 2 kV for power supply lines  ± 1 kV for input/output lines	AC power (“mains”) quality should be that of a typical commercial or hospital environment.
Surge IEC / EN 61000-4-5	± 1 kV lines/lines  ± 2 kV lines/earth	± 1 kV lines/lines  ± 2 kV lines/earth	AC power (“mains”) power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC / EN 61000-4-11	< 5% $U_T$ (> 95% dip in $U_T$ for 0.5 cycle)  40% $U_T$ (60% dip in $U_T$ for 5 cycles)  70% $U_T$ (30% dip in $U_T$ for 25 cycles)  < 5% $U_T$ (> 95% dip in $U_T$ for 5 s)	< 5% $U_T$ (> 95% dip in $U_T$ for 0.5 cycle)  40% $U_T$ (60% dip in $U_T$ for 5 cycles)  70% $U_T$ (30% dip in $U_T$ for 25 cycles)  < 5% $U_T$ (> 95% dip in $U_T$ for 5 s)	AC power (“mains”) power quality should be that of a typical commercial or hospital environment. If the user of the ventilator requires continued operation during power mains interruptions, it is recommended that the ventilator be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC / EN 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: $U_T$ is the AC mains voltage prior to application of the test level.			

**Table B-22.** Electromagnetic Immunity – Conducted and Radiated RF

The ventilator is intended for use in the electromagnetic environment specified below. The customer or the user of the ventilator should assure that it is used in such an environment.			
Immunity Test	IEC / EN 60601-1-2 Test Level	Compliance Level	Electromagnetic Environment–Guidance
Conducted RF IEC / EN 61000-4-6	3 Vrms 150 kHz to 80 MHz outside ISM bands <sup>a</sup>  10 Vrms inside ISM bands <sup>a</sup>	3 Vrms 150 kHz to 80 MHz outside ISM bands  10 Vrms inside ISM bands	<p>Portable and mobile RF communications equipment should be used no closer to any part of the ventilator, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.</p> <p><b>Recommended separation distance</b></p> <p><math>d = 0.35\sqrt{P}</math></p> <p><math>d = 1.2\sqrt{P}</math></p> <p><math>d = 1.2\sqrt{P}</math> 80 MHz to 800 MHz</p> <p><math>d = 2.3\sqrt{P}</math> 800 MHz to 2.5 GHz</p> <p>where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in metres (m)<sup>b</sup>.</p> <p>Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey<sup>c</sup>, should be less than the compliance level in each frequency range<sup>d</sup>.</p> <p>Interference may occur in the vicinity of equipment marked with the following symbol:</p> 
Radiated RF IEC / EN 61000-4-3	10 V/m 80 MHz to 2.5 GHz	10 V/m 80 MHz to 2.5 GHz	

**Table B-22.** Electromagnetic Immunity – Conducted and Radiated RF (Continued)

<p>Note:</p> <ul style="list-style-type: none"> <li>At 80 MHz and 800 MHz, the higher frequency range applies.</li> <li>These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.</li> </ul>	
<p><sup>a</sup> The ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.</p>	
<p><sup>b</sup> The compliance levels in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz are intended to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas. For this reason, an additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in these frequency ranges.</p>	
<p><sup>c</sup> Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the ventilator is used exceeds the applicable RF compliance level above, the Puritan Bennett™ 560 Ventilator should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the Puritan Bennett™ 560 Ventilator.</p>	
<p><sup>d</sup> Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 10 V/m.</p>	

**Table B-23.** Recommended Separation Distances

The ventilator is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the ventilator can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the ventilator as recommended below, according to the maximum output power of the communications equipment.				
Rated Maximum Output Power of Transmitter (W)	Separation Distance According to Frequency of Transmitter			
	150 kHz to 80 MHz (outside ISM bands) $d = 0.35 \sqrt{P}$	150 kHz to 80 MHz (in ISM bands) $d = 1.2 \sqrt{P}$	80 MHz to 800 MHz $d = 1.2 \sqrt{P}$	800 MHz to 2.5 GHz $d = 2.3 \sqrt{P}$
0.01	0.035 m	0.12 m	0.12 m	0.23 m
0.1	0.11 m	0.38 m	0.38 m	0.73 m
1	.35 m	1.2 m	1.2 m	2.3 m
10	1.1 m	3.8 m	3.8 m	7.3 m
100	3.5 m	12 m	12 m	23 m
For transmitters rated at a maximum output power not listed above, the recommended separation distance $d$ in metres (m) can be determined using the equation applicable to the frequency of the transmitter, where $P$ is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.				
<p>Note:</p> <ul style="list-style-type: none"> <li>At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.</li> <li>The ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.</li> <li>An additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas.</li> <li>These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.</li> </ul>				

**Table B-24.** Compliant Cables and Accessories

<b>Cable or Accessory</b>	<b>Maximum length</b>
UK AC power cable assembly	1.8 m (5.9 ft)
Japan AC power cable assembly	1.8 m (5.9 ft)
China AC power cable assembly	1.8 m (5.9 ft)
South Africa AC power cable assembly	1.8 m (5.9 ft)
India AC power cable assembly	1.8 m (5.9 ft)
Australia AC power cable assembly	1.8 m (5.9 ft)
Europe AC power cable assembly	1.8 m (5.9 ft)
Canada AC power cable assembly	1.8 m (5.9 ft)
Nurse call cable	5 m (16.4 ft)
12V DC car adapter cable	5 m (16.4 ft)
Oxygen inlet connector	-
FiO2 measurement kit	-
FiO2 sensor	-

## B.11 Standards Compliance and IEC Classification

### General Standards

- Medical Electrical Equipment: General Requirements for Safety IEC 60601-1:1990 and EN 60601-1:1990 and all its amendments up to 1995.
- The ventilator will be constructed to comply with the following product Classifications as detailed in Clause 5 of 60601-1:
  - Class II Equipment
  - Internally Powered Equipment
  - Type BF Applied Parts
  - IP31 with respect with respect to access to hazardous parts and ingress of moisture
  - Not suitable for use in the presence of flammable anesthetic mixtures
  - Not suitable for sterilisation
  - Suitable for continuous operation
  - Detachable power supply cable
- Supplement No. 1-94 to CAN/CSA-C22.2 No. 601.1-M90 - Medical Electrical Equipment - Part 1: General Requirements for Safety.
- UL 60601-1 Medical Electrical Equipment - Part 1: General Requirements for Safety: 2003.

### Collateral Standards

- Medical Electrical Equipment - Part 1: General Requirements for Safety -2- Collateral standard Electro-Magnetic Compatibility requirements and tests IEC 60601-1-2:2007 and EN 60601-1-2: 2007.
- Medical Electrical Equipment - Part 1: General Requirements for Safety -2- Collateral standard: Programmable Electrical Medical Systems IEC 60601-1-4:2000 and EN 60601-1-4:2004.
- Medical Electrical Equipment - Part 1: General Requirements for Safety -2- Collateral standard: Usability IEC 60601-1-6:2006 and EN 60601-1-6:2007.

- General Requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems IEC 60601-1-8:2003 and EN 60601-1-8:2007.

**Particular Standards**

- Lung Ventilators for Medical Use- Particular Requirements for Basic Safety and Essential Performance Part 2: Home Care Ventilators for Ventilator-Dependent Patient EN ISO10651-2:2009.
- Lung Ventilators for Medical Use- Particular Requirements for Basic Safety and Essential Performance Part 1: Home Care Ventilator Support YY 0600.1-2007 (ISO 10651-6:2004, MOD).
- Lung ventilators for medical use – Particular requirements for basic safety and essential performance – Part 2: Home care ventilators for ventilator – dependent patients YY 0600.2-2007 (ISO 10651-2:2004, MOD).
- Medical electrical equipment – Part 2: Particular requirements for the safety of lung ventilators – Critical care ventilators GB 9706.28-2006 (IEC / EN 60601-2-12:2001, MOD)
- Anesthetic and respiratory equipment - Conical connectors - Part 1: Cones and sockets EN ISO 5306-1:2004.

**Air Transportation Standards**

- Environmental Conditions and Test Procedures for Airborne Equipment - RTCA/DO-160:2007.

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# C Theory of Operation

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## C.1 Architecture

The Puritan Bennett™ 560 Ventilator's gas delivery system is primarily composed of an airflow generator and a three-way valve to control the patient circuit exhalation valve. The flow generator is a low-inertia, micro-turbine driven by a brushless DC electric motor, while the three-way valve is a proportional solenoid valve.

These two actuators are microprocessor-controlled and perform according to specific control algorithms. The microprocessor control circuit receives its data from the various servo-controlled pressure and feedback flow sensors that<sup>1</sup> are built into the ventilator.

An electrical supply management system performs the energy conversions necessary for operation and switching between the available power sources and the regulated load of the internal battery.

A cooling fan helps maintain the proper operating temperature range for the internal environment of the ventilator. This fan is servo-controlled to maintain the proper temperature for the most heat-sensitive of the ventilator's components.

## C.2 Operation

The operation of the device is based on a self-adapting, closed loop drive system. The speed of the flow generator (turbine) is servo-controlled according to the patient pressure signal or the inspired flow signal.

The turbine speed control algorithms themselves are based on equations that vary according to the ventilation modes, settings, and the respiratory cycle phases. Thus, fixing the pressure rise time or flow pattern has an influence on the level of turbine acceleration at the start of the inspiration phase. The transition between the inspiration phase and expiration phase is controlled by a deceleration or braking algorithm proportional to the pressure difference between the two phases.

The exhalation solenoid valve (three-way valve) is fully closed during the inspiratory phase and is proportionally controlled during the exhalation phase to obtain the bias flow. The speed of the turbine adapts to the exhalation pressure threshold during the entire exhalation phase to maintain the operator-set PEEP.

The flow measurement completes the system by enabling detection of patient inspiratory effort and the triggering of inspiration phases. The flow measurement can also be used to determine the end of the inspiration phase in certain ventilation modes.

The flow measurement is automatically corrected as a function of the atmospheric pressure measured inside the ventilator with the Altitude Compensation feature<sup>1</sup>. The flow and volume are in Body Temperature Pressure Saturated (BTPS) conditions. This necessitates that periodic inspections for calibrating the sensors be performed by maintenance technicians authorised by Covidien (refer to the Puritan Bennett™ 560 Ventilator Service Manual).

If the Altitude Compensation feature is active, a corrective algorithm is applied to the inspiration and exhalation flow for volume calculation and the flow set point in volume breath.

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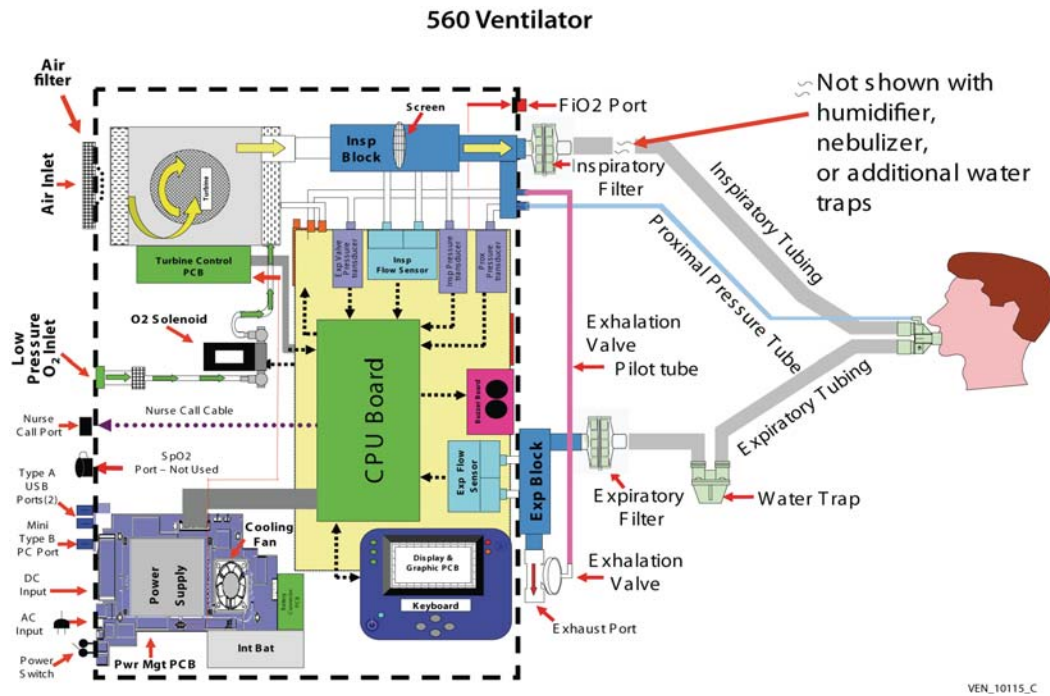
1. The Altitude Compensation feature is enabled (set to "YES" on the Setup Screen) by default and should remain at this setting.

The sensor measurement range is software limited from 600 to 1100 hpa.

A cooling fan is provided to maintain the internal temperature of the ventilator within specified limits and to help ensure proper performance and longevity of the device.

Finally, the various measurement signals used in control and detection are protected and specifically filtered in order to limit any risk of disturbance to the device and possible problem.

Figure C-1 for an illustration of the ventilator's gas delivery system.



**Figure C-1.** Gas Delivery System

# D Modes and Breath Types

## D.1 Modes of Ventilation

This chapter is a general description of the various modes of ventilation and breath types available with the Puritan Bennett™ 560 Ventilator.

**Note:**

The default ventilation mode setting is P A/C; for more information, see below.

### D.1.1 Assist/Control (A/C) Modes

When set to an Assist/Control mode, machine-initiated breaths are delivered at a clinician-set volume or pressure, inspiratory time, and rate. If the patient triggers a spontaneous breath between machine breaths, the ventilator will deliver a breath based on the volume or pressure settings and inspiratory time.

Whether initiated by the patient or the ventilator, all breaths are delivered at the same preset volume or pressure and inspiratory time.

The names of the Assist/Control modes are:

- V A/C, if the breaths are based on a volume setting
- P A/C, if the breaths are based on a pressure setting

### D.1.2 SIMV Modes

When set to a SIMV (Synchronised Intermittent Mandatory Ventilation) Mode, machine-initiated breaths are delivered at a clinician-set volume or pressure, inspiratory time, and rate. These mandatory breaths are synchronised with patient effort. If the patient triggers a spontaneous breath between machine breaths, the ventilator will deliver a spontaneous breath, which is pressure-supported.

CPAP spontaneous breaths are not available in SIMV modes.

The names of the SIMV modes are:

- V SIMV, if mandatory breaths are based on a volume setting
- P SIMV, if mandatory breaths are based on a pressure setting

### D.1.3 CPAP Mode

In CPAP, the ventilator maintains a constant level of pressure in the patient's airway.

### D.1.4 PSV Mode

PSV mode maintains a constant level of pressure in the patient's airway during exhalation. In addition, the ventilator applies a clinician-set pressure (Pressure Support) to each of the patient's breaths. This has the same benefits as CPAP, with the additional benefit of assisting the patient in moving gas into his or her lungs.

## D.2 Breath Types

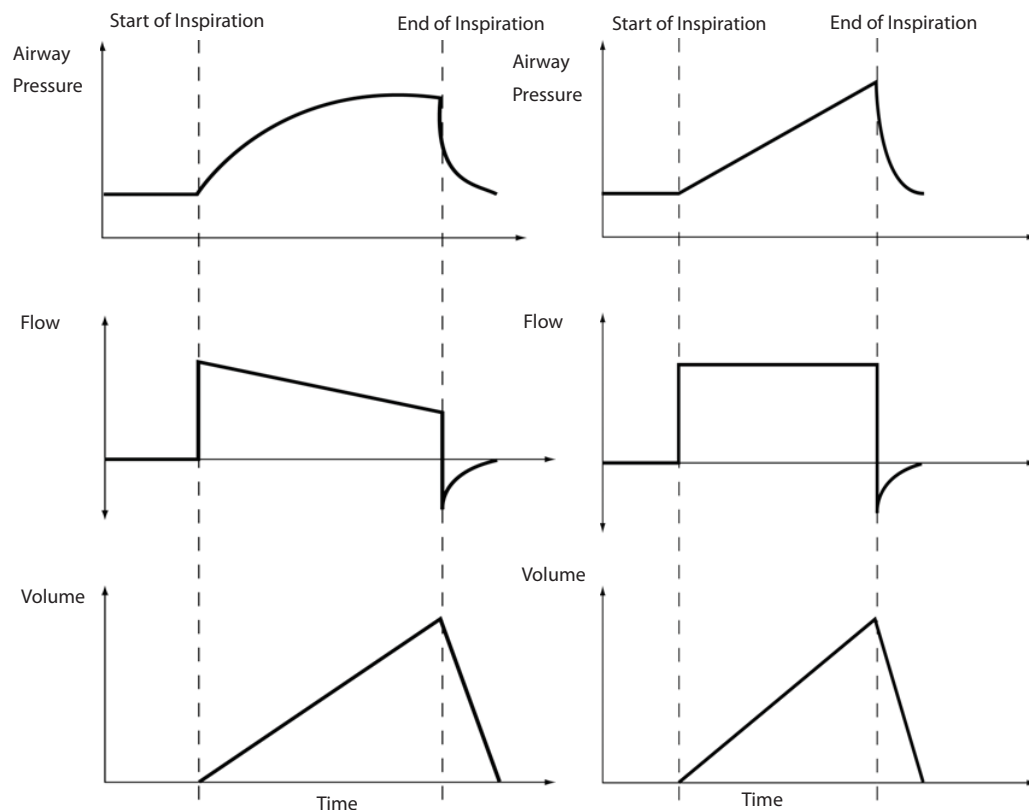
Breath types available from the ventilator are:

- Volume controlled breaths in Assist/Control mode (in V A/C or V SIMV)
- Pressure controlled breaths in Assist/Control mode (in P A/C or P SIMV)
- Pressure-supported breaths in SIMV mode (V SIMV and P SIMV) or PSV
- CPAP

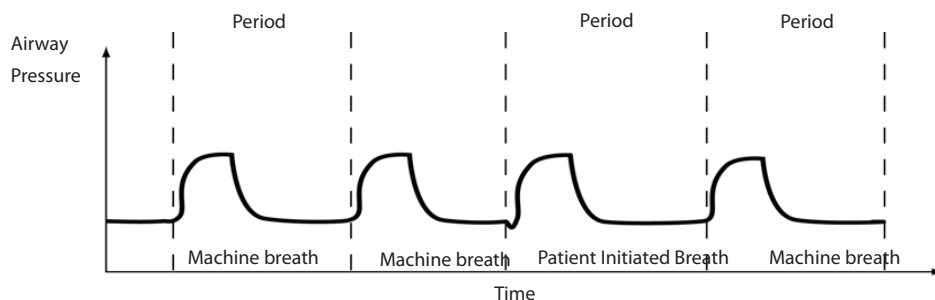
### D.2.1 Volume Breaths in Assist/Control Mode

In V A/C each delivered breath will be of the selected volume ( $V_t$ ), delivered over the selected inspiratory time (calculated with R Rate and I:E (I/T) ratio). Inspiration is triggered by patient-generated flow (for assisted breaths) or by the ventilator. For controlled breaths, breath rate (R-Rate) is the controlling parameter. For both controlled and assisted breaths, the inspiration is limited by the volume and is cycled by inspiratory time (Insp Time).

The shape of the flow waveform can be either a decelerated (D), a (SQ) square, or sinusoidal (S) flow patterns according to the Flow Pattern setting:



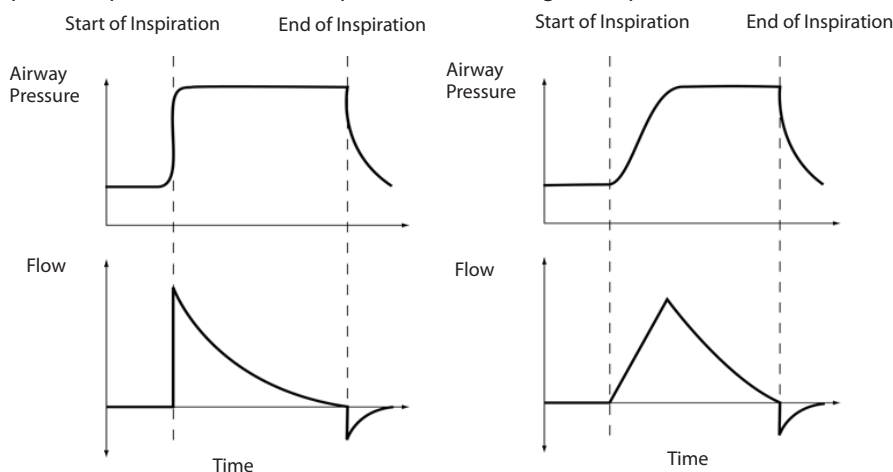
A/C mode guarantees a maximum period between breaths, as determined by the Breath Rate setting. In the waveform below, the ventilator delivers a controlled (machine) breath, and calculates the time before another controlled breath must be delivered. The ventilator delivers a second controlled breath at the conclusion of the machine calculated breath time (for simplicity, we will use the term *period* for "machine-calculated breath time"). Following the second controlled breath, but before another period can elapse, the patient's effort triggers an assisted (or patient-initiated) breath. This restarts the period. At the conclusion of the period, the ventilator delivers another controlled breath.



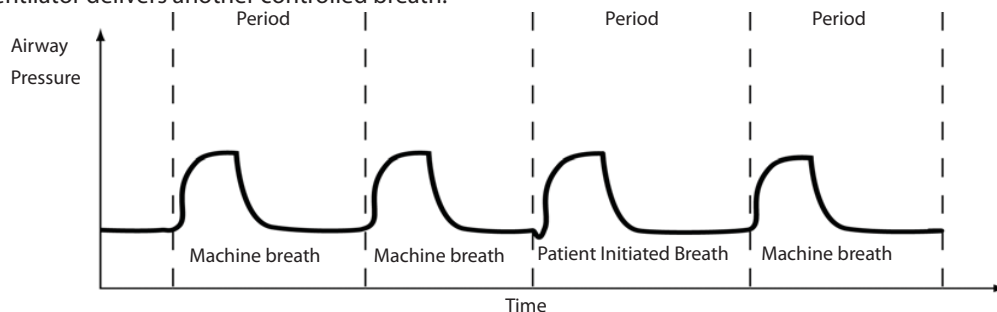
### D.2.2 Pressure Control Breaths in Assist/Control Mode

In Assist/Control mode (P A/C), each delivered breath will maintain the selected pressure (P Control) maintained over the selected inspiratory time (calculated with R Rate and I:E (I/T) ratio). Inspiration is triggered by patient-generated flow (for assisted breaths) or by the ventilator (for controlled breaths; breath rate [R-Rate] is the controlling parameter). For both controlled and assisted breaths, the inspiratory pressure is limited to the pressure (P Control) setting, and is cycled by time.

The shape of the pressure waveform depends on the setting of the pressure rise time (Rise Time).



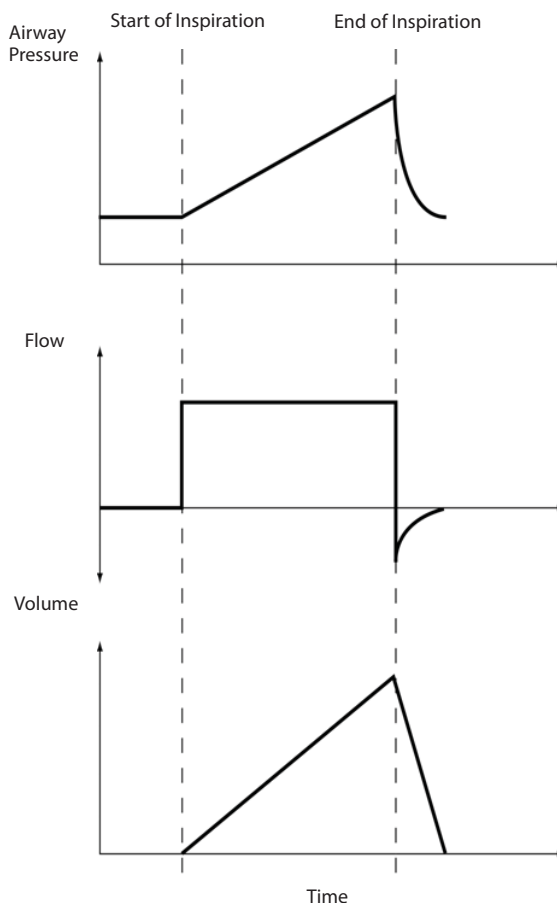
P A/C mode guarantees a maximum period between breaths, as determined by the Breath Rate setting. In the next waveform (shown on the following page), the ventilator delivers a controlled (machine) breath, and calculates the time before another controlled breath must be delivered. The ventilator delivers a second controlled breath at the conclusion of the machine calculated breath time (for simplicity, we will use the term *period* for “machine-calculated breath time”). Following the second controlled breath, but before another period can elapse, the patient's effort triggers an assisted (or patient-initiated) breath. This restarts the period. At the conclusion of the period, the ventilator delivers another controlled breath.



### D.2.3 Volume Breaths in V SIMV Mode

In V SIMV the mandatory volume breaths deliver the selected volume ( $V_t$ ) over the selected inspiratory time (Insp Time). Inspiration is triggered by patient-generated flow (for assisted breaths) or by the ventilator (for controlled breaths; breath rate [R-Rate] is the controlling parameter). For both controlled and assisted breaths, the inspiration is limited by the volume and is cycled by volume and time.

The shape of the flow of volume cycles is of the Square type. See the waveforms below.



SIMV mode will also deliver pressure supported breaths (refer to the description for Pressure supported breaths). The SIMV mode is a combination of mandatory volume breaths and pressure supported breaths. The alternation between them is determined by the setting of breath rate (R-Rate) or period.

In addition, the back up rate will enable the ventilator to ventilate in the case of patient apnea. The back up rate is equal to the maximum between 8 and the breath rate (R-Rate). The “controlled” cycles following an apnea event will be volume cycles. These cycles end as soon as a new inspiration trigger is detected.

When the patient triggers a breathing effort, the volume and pressure cycles alternate between each other according to the breath rate setting (R-Rate). All the cycles are synchronised on inspiration triggers. A period always includes a volume cycle, plus as many pressure cycles as have been triggered by the patient; beyond the period the following inspiration trigger will initiate a new volume cycle, and so forth. Refer to the waveforms on the following page.

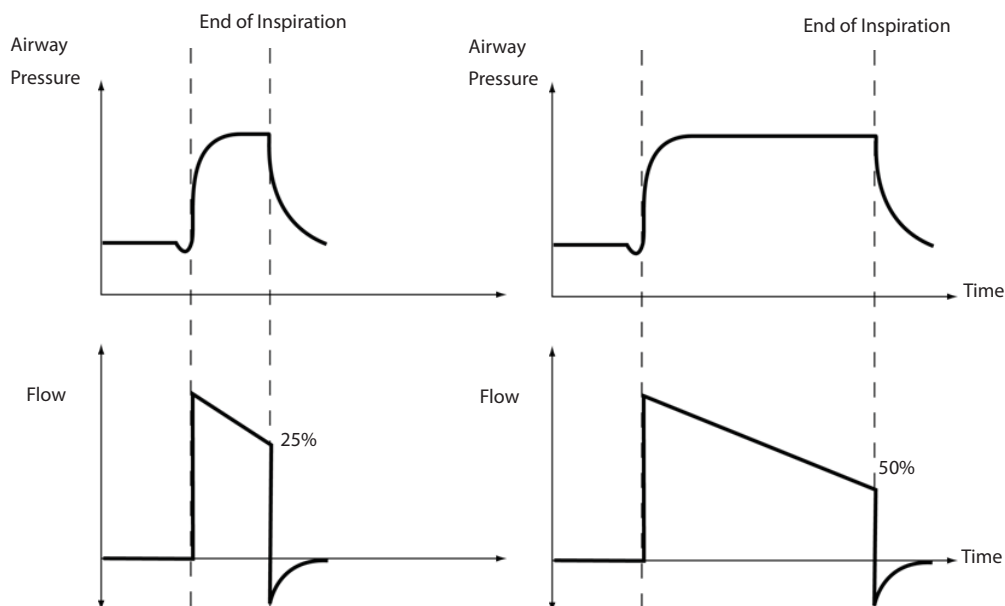


### D.2.4 Pressure Supported Breaths in SIMV and PSV Modes

In P SIMV (or Synchronised) and PSV modes, the supported breaths maintain the selected pressure (P Support). Inspiration is triggered by patient-generated flow. The inspiration is terminated when inspiratory flow drops to the Exhalation Sensitivity (E Sens) setting).

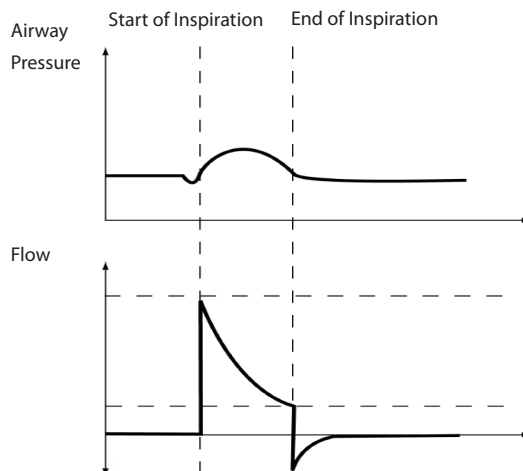
In P SIMV, additional mandatory pressure breaths will be delivered, dependent on the selected Breath Rate (Rate).

The shape of the pressure waveform depends on the setting of the pressure rise time (Rise Time). Refer to the waveforms shown below.



### D.2.5 CPAP

In Continuous Positive Airway Pressure (CPAP) the ventilator maintains pressure at the selected PEEP over the entire breath cycle. Inspiration is triggered by patient-generated flow. Inspiration is limited by the pressure and is cycled by the patient when inspiratory flow drops to the Exhalation Sensitivity threshold (E Sens = 25%). Refer to the waveforms shown below.



## D.3 Ventilation Modes and Apnea

In SIMV mode with apnea time (Apnea Time) settings, the ventilator will sound an APNEA alarm if no patient effort occurs during the apnea time. During an APNEA alarm, the ventilator delivers breaths at a breath rate (backup rate) equal to the maximum of eight (8) and the breath rate setting (R-Rate). If the patient initiates a spontaneous breath, the ventilator will stop the controlled breaths and return to the previous operating parameters.

In PSV mode, the back-up rate is activated so that the ventilator will automatically begin to deliver breaths at the breath rate (Backup R) setting if no patient effort occurs for the Apnea Time setting. The pressure during a back-up breath is equal to the Pressure Support (P Support) setting before the apnea condition began. If the patient initiates a spontaneous breath while the back-up rate is in effect, the ventilator will return to the previous operating parameters.

In CPAP, a backup rate is not set, but the operator must still set an apnea time (Apnea Time). In that case, the ventilator will sound an APNEA alarm if no breath is triggered by the patient in the apnea time; however, no back up breaths will be generated.

# E Operational Verification Checklist

The operational verification and safety checks listed in [Table E-1](#) below should be performed to ensure the ventilator is operating properly in the following circumstances:

- Prior to using the ventilator with a patient
- Monthly while the ventilator is in use
- Following maintenance or changes in ventilator settings

If the ventilator fails any of the safety checks below, or if you cannot complete these checks, refer to section 5.8, “[Troubleshooting](#),” on page 5-15 or call the equipment supplier or Covidien (refer to section 10.5, “[Service Assistance](#),” on page 10-8).




## WARNING

**Provide the patient with an alternate means of ventilation before conducting these tests.**

**To reduce the risk of infection, wash your hands thoroughly before and after handling the ventilator or its accessories.**

**Table E-1.** Operational Verification Checklist

1	Verify the proper appearance and cleanliness of the ventilator.	<input type="checkbox"/> Pass
2	Verify all of the labels and markings on the ventilator are clear and legible.	<input type="checkbox"/> Pass
3	Confirm the air inlet filter is clean and correctly installed.	<input type="checkbox"/> Pass
4	Ensure the AC power cable does not exhibit any signs of damage, such as kinks, breaks, or damaged insulation.	<input type="checkbox"/> Pass
5	Connect the AC power cable. Ensure that all power supply indicators on the front panel flash, except for the AC power supply (mains) indicator, which should remain lit.	<input type="checkbox"/> Pass
6	Push the power switch <b>I/O</b> to the <b>I</b> position to activate the ventilator test: Check that the two alarm indicators and the Standby indicator (located close to the <b>VENTILATOR ON/OFF</b>  key) flash. Ensure also that the two alarm buzzers sound.	<input type="checkbox"/> Pass
7	Perform the Functioning Alarms Test (refer to <a href="#">Appendix F, “Alarms Tests”</a> ). Check	<input type="checkbox"/> Pass
8	Verify the alarm volume is adapted to the patient environment. Refer to section 7.3, “ <a href="#">Preferences Menu Parameters</a> ,” on page 7-8 for instructions on changing the alarm volume setting.	<input type="checkbox"/> Pass
9	Verify that the preventive maintenance schedule for the ventilator is followed. Refer to chapter 10, “ <a href="#">Routine Maintenance</a> ”.	<input type="checkbox"/> Pass
10	Ensure the patient breathing circuit is correctly attached to the ventilator, with all the necessary components, and is free from any signs of damage and leaks. If exhaled volume monitoring is required, use the double-limb circuit for exhaled tidal volume monitoring.	<input type="checkbox"/> Pass

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# F Alarms Tests

Before connecting the ventilator to the patient, perform the following tests to ensure the ventilator's alarms are working properly.



## WARNING

**Do not perform ventilator alarm tests while the patient is connected to the ventilator. Provide the patient with an alternate means of ventilation before conducting these tests.**

**If the ventilator fails any alarm test or if you cannot complete these tests, see the Troubleshooting section (refer to chapter 5, "Alarms and Troubleshooting") of this manual or call your equipment supplier or Covidien (refer to section 10.5, "Service Assistance," on page 10-8).**

**The setting of the Min PIP alarm must be adjusted for the patient, but must also be set high enough to allow the PATIENT DISCONNECTION alarm to trigger properly. Perform the Low Pressure Test (refer to section F.1, "Low Pressure Test," on page F-1) to ensure the Min PIP alarm is properly set.**

## Note:




Most of these tests require that an approved patient circuit be connected to the ventilator. Ensure that your patient circuit is properly connected prior to performing these tests.

## F.1 Low Pressure Test



## WARNING

**The setting of the Min PIP alarm must be adjusted for the patient, but must also be set high enough to allow the PATIENT DISCONNECTION alarm to trigger properly. Perform the following test to ensure the Low PIP alarm is properly set.**

1. Before proceeding, set the ventilation and alarm parameters specified by the patient's clinician and specify a single or dual circuit setup.
2. Press the **VENTILATION ON/OFF**  key to start ventilation.
3. Keep the patient's end of the breathing circuit open and allow ventilation to continue.
4. Wait for (Apnea Time + 2 seconds; Apnea time is not always 5 seconds), then ensure that:
  - the High priority indicator (red colour) lights up
  - the "PATIENT DISCONNECTION" alarm is displayed
  - the audible alarm sounds
5. Press the **ALARM CONTROL**  key once to silence the alarm.
6. Press the **VENTILATION ON/OFF**  key for three (3) seconds, then release it. The ventilator will switch to Standby mode and cancel the alarms.

## F.2 Apnea Test



Apnea breaths only apply in PSV, CPAP and SIMV modes.

1. Connect the patient end of the patient circuit to a test lung.
2. Verify that the pressure tube of the patient circuit is properly connected to the appropriate fitting on both the ventilator and the proximal pressure port (refer to section 6.4, “Patient Circuit,” on page 6-6).

3. Press the **VENTILATION ON/OFF**  key to start ventilation.

The ventilator will deliver a mandatory breath. Before the second mandatory breath is delivered, verify that the following events occur:


- the Medium priority indicator (yellow colour) illuminates
- the “APNEA” alarm is displayed
- an audible alarm sounds

4. Press the **ALARM CONTROL**  key *twice* to reset the alarm.
5. Press the **VENTILATION ON/OFF**  key for three (3) seconds before releasing it. Ventilation stops.

## F.3 Power Failure Test

### Note:

If the ventilator is operating on either the external power supply or the internal battery, you must plug it in to an AC power source before beginning this test.

1. Disconnect the ventilator from its AC power supply. Ensure that the following events occur:
  - the Medium priority indicator (yellow colour) illuminates
  - the “AC POWER DISCONNECTION” alarm activates
  - an audible alarm sounds
  - the **DC POWER** indicator illuminates if the DC power source is connected; otherwise, the INTERNAL BATTERY indicator illuminates
2. Press the **ALARM CONTROL**  key *twice* to reset the alarm.
3. Reconnect the ventilator to its AC power supply.

## F.4 Occlusion Test




### Note:

Occlusion testing can only be done in Pressure modes.


1. When using a single limb circuit do the following:
2. Verify that the pressure tube of the patient circuit is properly connected to the appropriate fitting on both the ventilator and the proximal pressure port (refer to section 6.4, “Patient Circuit,” on page 6-6).
3. Block the exhalation port on the exhalation valve of the patient circuit. Refer to Figure F-1 on page F-3.





**Figure F-1.** Blocking the Patient End of a Single Limb Circuit

4. Press the **VENTILATION ON/OFF**  key to start ventilation.
5. Allow the ventilator to deliver three (3) consecutive breaths. At the beginning of the fourth breath, ensure that the following events occur:
  - the High priority indicator (red colour) illuminates
  - the “Occlusion” alarm activates
  - an audible alarm sounds
6. Press the **ALARM CONTROL**  key to silence the alarm.
7. Unblock the exhalation port.
  - The alarm is cancelled.
8. Press the **VENTILATION ON/OFF**  key for three (3) seconds before releasing it.
  - Ventilation stops.




## F.5 High Pressure Test

1. Set the ventilator to V A/C mode and set the following parameter values:
  - Vt: 250 ml
  - PEEP: OFF
  - Flow Pattern: D
  - R-Rate: 30 bpm
  - I:E: 1/4 or I/T: 20%
  - Insp Sens: 3
  - High Pressure Alarm: 12 mbar
  - Low Pressure Limit must be 4 or lower
2. Connect the patient end of the patient circuit to a *Maquet test lung*.
3. Verify that the pressure tube of the patient circuit is properly connected to the appropriate fitting on both the ventilator and the proximal pressure port (refer to section 6.4, “Patient Circuit,” on [page 6-6](#)).
4. Press the **VENTILATION ON/OFF**  key to start ventilation.
5. Allow the ventilator to deliver three (3) consecutive breaths. At the beginning of the fourth breath, ensure that:
  - the High priority indicator (red colour) illuminates
  - the HIGH PRESSURE ALARM activates.

- an audible alarm sounds
- 6. Press the **ALARM CONTROL**  key once to silence the alarm.
- 7. Set the High Pressure parameter value to 40 mbar.
  - The alarm is cancelled.
- 8. Press the **VENTILATION ON/OFF**  key for three (3) seconds.
  - Ventilation stops.



## F.6 Testing the Battery

The ventilator is capable of testing the power of the battery (refer to chapter 8, “Internal Battery”). You can determine which power source the ventilator is using by checking the power indicator, located on the top panel. The indicator light will be lit to indicate which power source is currently available.

1. Disconnect the AC power supply cable and the DC power cable (if it is connected) from the ventilator.
  - a POWER DISCONNECTION alarm will trigger.
2. Press the **ALARM CONTROL**  key twice to pause the alarm. Ensure that the following events occur:
  - the INTERNAL BATTERY indicator to the upper-left of the display illuminates
  - the BATTERY  symbol is displayed at the top of the screen (along with its reserve capacity)
3. Connect the AC (mains) power supply. Ensure that the following events occur:
  - the AC POWER indicator to the upper-left of the display illuminates
  - the indicator to the upper-left of the display is flashing, which indicates that the battery is charging (this only occurs if the ventilator has run on battery power long enough to lose enough charge that the charger will turn on)
  - the BATTERY  to the upper-left of the display symbol is no longer displayed at the top of the screen

## F.7 Involuntary Stop Test

To verify proper functioning of the Very High Priority audible alarm, perform the following.

1. Press the VENTILATION ON/OFF  key to start ventilation.
2. Set the **I/O** switch to the **O** (off) position to power-down the ventilator during ventilation. Ensure that the following events occur:
  - An audible alarm sounds continuously
  - The ventilator turns off. There should be no alarm indicators illuminated and no alarm messages displayed.
3. Press the **ALARM CONTROL**  key once to silence the audible alarm.

---

# G Unpacking and Preparation

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The Puritan Bennett™ 560 Ventilator is delivered with the following items:

- (1) Printed User's Manual (language as requested by the customer)
- (1) Clinician's Manual on CD (a print copy is available upon request by the customer)
- (1) Patient circuit and valve
- (1) Set of six (6) combination foam/fine particle air inlet filters
- (1) Carrying bag
- (1) Oxygen connector
- (1) AC power cable



## **WARNING**

**Users must always possess an additional circuit and valve while using the Puritan Bennett™ 560 Ventilator. To minimise the risk of damage, you must use the Dual Bag to transport the Puritan Bennett™ 560 Ventilator. Refer to Figure G-2.**

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To unpack and prepare the ventilator, follow the steps below.

1. From the plastic bag, remove the following:
  - Plastic pocket containing the Clinician's Manual.
  - The ventilator and its components and/or accessories.
2. Remove the patient circuit, the AC ("Mains") power cable, and the set of fine-particle air inlet filters
3. Inspect the ventilator and ensure that:
  - the ventilator's outer casing and the I/O switch's protective cover do not have any dents or scratches, which may indicate possible damage.
  - the ventilator's labels and markings are clear and legible.
  - the AC power cable does exhibit any signs of damage, such as kinks, breaks, or cuts.

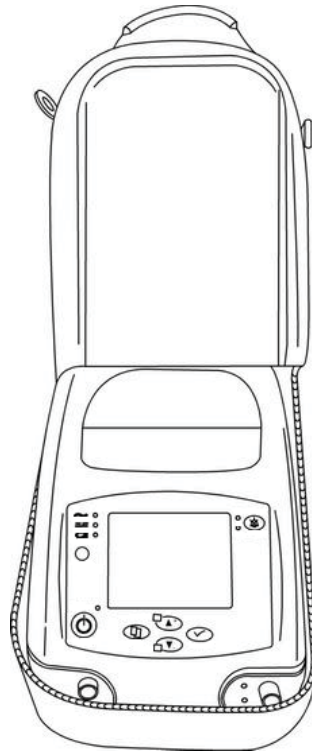


## **WARNING**

**Never use a ventilator or any components or accessories that appear to be damaged. If any signs of damage are evident, contact your equipment supplier or Covidien.**

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4. Clean the ventilator with a mild soap solution, if necessary (refer to chapter 9, "Cleaning").
5. Ensure that the air inlet filter is installed.



**Figure G-1.** Puritan Bennett™ 560 Ventilator



**Figure G-2.** Dual Bag

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# H Parts and Accessories

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[Table H-1](#) provides a list of accessories that are available for the Puritan Bennett™ 560 Ventilator.

To order parts or accessories, contact your equipment supplier or Covidien representative.

**Note:**

The ventilator is delivered with the following items: a printed User's Manual, a CD with Clinician's Manual (printed copy available upon request); one patient circuit with valve; one set of six (6) combination foam/fine particle air inlet filters; one carrying bag; one O<sub>2</sub> connector; and one AC power cable.

**Table H-1.** List of Consumables and Accessories

Description
Carrying bag (grey)
Oxygen inlet connector
Ventilator Cart
Dual Bag delivered with: Backpack Padded Straps, 2 ea. Suspension belt Carrying belt
 <b>WARNING</b> <b>To minimise the risk of damage, you must use the ventilator's Dual Bag to transport the ventilator. See <a href="#">Figure G-2</a> on page G-2.</b>
AC (mains) power cable
DC power cable (for connection to an external DC power source, such as a car 12 volt DC outlet)
Nurse call cable (5 metres)
Exhalation block, single-patient use (blue)
Inlet air combi-filter, fine (pack of 6) <b>Note:</b> This is the "foam plus fine particle" filter listed in Table 10-1, <a href="#">Consumables and Replacement Intervals</a> , on page 10-6).
Internal battery
External battery
<b>DAR Inspiratory Bacteria Filters</b>
Barrierbac
Barrierbac S
Barrierbac S Angled
Hygrobac
Hygrobac S
Hygrobac S Angled

**Table H-1.** List of Consumables and Accessories

Description
Hygroboy
Hygroster
Hygroster Mini
Sterivent
Sterivent S
Sterivent Mini
Hygrolife II

Table H-2 provides a list of consumable parts available for the ventilator.

**WARNING**

To ensure proper performance of the ventilator, use a patient circuit recommended by Covidien in this manual; refer to chapter 6, “Installation and Assembly” and Appendix H, “Parts and Accessories”. The total specified length of the patient circuit tubing as measured from the ventilator outlet to the ventilator inlet is 1.1 metres (3.6 ft) to 2.0 metres (6.6 feet). The tubing must conform to all applicable standards and must be fitted with Ø 22 mm terminals that also conform to all applicable standards. Ensure that both the length and the internal volume of the patient circuit are appropriate for the tidal volume: a corrugated tube of Ø 22 mm for adult patients, and a corrugated tube of Ø 15 mm for pediatric patients with a tidal volume lower than 200 ml.

**Table H-2.** List of Circuits

Description	Part Number
DAR Double limb patient circuit with exhalation valve, 180 cm, PVC, ADULT	5094000
DAR Double limb patient circuit with exhalation valve, 180 cm, PVC, PEDIATRIC	5093900
DAR Single limb patient circuit with exhalation valve, 180 cm, PVC, ADULT	5093600
DAR Single limb patient circuit with exhalation valve, 180 cm, PVC, PEDIATRIC	5093500
DAR Single limb patient circuit without exhalation valve, 180 cm, PVC, ADULT	5093300
DAR Single limb patient circuit without exhalation valve, 180 cm, PVC, PEDIATRIC	5093100

For more information regarding parts and accessories for the Puritan Bennett™ 560 Ventilator contact your service representative or [www.puritanbennett.com](http://www.puritanbennett.com).

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# I Glossary

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## **AC Power**

Alternating current.

## **Alarm Pause**

The audible and visual alarms cease and the  symbol appears. The symbol will remain until the cause of the alarm is addressed. For example, when the ventilator is running on internal battery, the AC Disconnection alarm may be paused, and the alarm paused symbol will appear until the device is plugged into AC. The paused alarm will be captured in the alarm log screen and can be reactivated.

## **Alarm Reset**

Used only for the High Pressure alarm, this function resets the visual alarm message.

## **Apnea**

The absence of breathing or a breathing pattern capable of supporting an individual's respiratory needs.

## **AI - Apnea Index**

The Apnea index is average number of apnea events per hour of ventilation. It is based on the Apnea Alarm.

## **Apnea Time**

Time allowed between breath starts before APNEA alarm occurs when no patient effort is detected.


## **Assist/Control**

In Assist/Control mode, the ventilator delivers an assisted breath of a set volume or set pressure when the patient's breathing effort creates a flow or pressure drop that is greater than the SENSITIVITY setting. In absence of patient breathing effort, the ventilator will deliver a controlled breath of the set volume or pressure. (Does not apply in PSV/CPAP mode).

## **Assisted Breath**

A volume or pressure breath triggered by the patient but then controlled and terminated by the ventilator.

## **Audio Pause**

Pauses the audible alarm for 60 seconds at a time and shows the  symbol; often referred to as "Alarm Silence."

## **Back Up Rate**

Rate of control cycles in PSV or SIMV modes during apnea phase.

## **Battery Level**

Display of the remaining battery capacity; located adjacent to the battery symbol.

**Bias flow**

Turbine flow during exhalation phase through the patient circuit to avoid rebreathing.

**bpm**

An abbreviation for “breaths per minute,” which is the unit of measure for breath rate (see below).

**Breath Rate (Back Up R)**

The total number of breaths, both machine and spontaneous, delivered by a ventilator in one minute.

**Caregiver**

An individual who assists a patient with the tasks of daily living. This may be a family member, a live-in assistant, or the nursing staff of a health care facility.

**cmH<sub>2</sub>O**

An abbreviation for “centimetres of water,” which is a unit of measure for pressure.

**CPAP (Continuous Positive Airway Pressure)**

Continuous airway pressure maintained throughout a spontaneous breath cycle.

**Controlled breath**

A volume or pressure breath triggered, controlled and terminated by the ventilator.

**DC Power**

Direct current.

**Double Limb Patient Circuit**

Patient circuit with a tube between the ventilator gas outlet and the patient for inspiratory gas and another tube between the patient and the exhalation block for exhalation gas.

**Exhalation Block**

Part of the ventilator that allows the connection of the exhalation limb of the patient circuit. The exhalation block is for single-patient use only.

**Exhalation Phase**

Phase of the breath cycle during which the patient exhales.

**Exhaled Tidal Volume (VTE)**

Exhaled volume measured for all breath types through the exhalation block. Monitored value available only with double limb patient circuit.

**Exhalation Sensitivity**

The exhalation sensitivity (E Sens) level is a percentage of peak flow at which a pressure-supported breath will be terminated.

**Exhalation Tidal Volume (VTE)**

Volume exhaled by the patient at each exhalation phase.

**Fraction of Inspired Oxygen (FiO<sub>2</sub>)**

Amount of oxygen delivered to the patient.

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**FiO<sub>2</sub> Sensor**

The sensor which measures the amount of oxygen being delivered to the patient.

**Flow**

Volume of gas delivered by the ventilator compared to time, expressed in litres per minute (lpm).

**Flow Pattern (Ramp Setting)**

This is the flow distribution shape during the inspiration phase. There are three flow patterns available: Square waveform or constant flow, Decelerated (sawtooth waveform) or decreasing flow and Sinusoidal flow.

**Freeze**

Interruption of the waveform plot tracing on the ventilator's display.

**hPa**

An abbreviation for "hectopascal" which is a unit of measure for atmospheric pressure.

**I:E ratio**

Inspiratory time versus exhalation time ratio.

**Inspiratory Phase**

Phase of the breath cycle during which the patient inspires.

**Inspiratory Sensitivity (I Sens)**

Level of inspiratory effort the patient has to provide during the initiation of a machine breath. The sensitivity levels (from 1P to 5) correspond to differences in flow compared to the bias flow. Level 1P is the most sensitive (for a pediatric use) and requires the least effort to trigger a breath. Level 5 requires the most amount of effort to trigger a breath.

**Inspiratory Tidal Volume (VTI)**

Volume delivered to the patient at each inspiratory phase.

**I Time (Inspiratory Time)**

Inspiratory time measure.

**Intentional Vent Stop Alarm**

Intentional Ventilation Stop Alarm - Ventilation has been switched off by the user / caregiver and the ventilator is in stand-by.

**I/T Ratio**

Inspiratory time versus total breath time ratio.

**L**

litres (a unit of volume).

**Leak**

When ventilating with a double limb circuit in leak configuration, it is the average parasitic leak during each cycle and over the past 24 hour period. When ventilating with a single limb circuit there is no average leak.

**LED**

Light Emitting Diode; used as indicator lights on the ventilator's front panel.

**lpm**

Litres Per Minute (a unit of volume flow rate).

**Machine Hours**

Counter for the total ventilation time since manufacture or the last CPU board change.

**Mains**

AC power supply.

**MAP**

Mean Airway Pressure. Average pressure during a ventilation cycle.

**Max Leak**

The maximum alarm setting of a high leakage threshold. An alarm will be triggered in the event the calculated leakage is exceeded.

**Max R<sub>tot</sub> (Total breath rate)**

The maximum alarm setting to prevent hyperventilation or ventilator autotriggering. The HIGH RATE alarm will be triggered if the total breath rate exceeds the maximum limit set.

**Max P (Maximum Inspiration Pressure)**

Max P allows the ventilator to adjust the inspiratory pressure up to a maximum limit in order to reach the target tidal volume (V<sub>t</sub> Target).

**Mbar**

An abbreviation for "millibar" which is a unit of measure for atmospheric pressure.

**Mean Airway Pressure**

Average patient pressure during each breath.

**Minimum Exhalation Time**

Minimum exhalation time before allowing the patient inspiratory trigger.

**Minimum Inspiratory Time**

Minimum inspiratory time before allowing the patient to exhale.

**M Vol (Minute Volume)**

Flow delivered at each breath to the patient is measured by the inspiratory flow sensor and that measurement is used to calculate minute volume (V<sub>t</sub> x R<sub>tot</sub>)

**P A/C (Pressure Assist /Control)**

A ventilator mode which provides machine-initiated breaths delivered at a clinician-set pressure, inspiratory time, and rate.

**Patient Breath**

Breathing cycle initiated by the patient.

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**Patient Counter**

Counter of ventilation time for the patient.

**Patient effort**

Inspiratory effort initiated by the patient.

**Patient circuit**

Tubing between the ventilator and the patient.

**Pause**

Waveforms freezing function.

**PAW (Peak Airway Pressure)**

The Peak Airway Pressure is the average peak pressure during the inspiratory phase, measured by each cycle and over the previous 24 hour period.

**Peak Inspiratory Pressure (PIP)**

The highest pressure measured in the patient circuit during the inspiration phase.

**Positive End Expiratory Pressure (PEEP)**

Pressure in the patient circuit at the end of expiration.

**Pressure Control (P Control)**

Augmentation of the patient's ventilation synchronously with inspiratory effort until a preset pressure is met. Pressure is maintained throughout patient inspiratory flow, and is cycled to expiration by time (controlled by the selected Inspiratory Time setting). Used in Assist/Control mode.

**Pressure Support (P Support)**

Augmentation of the patient's ventilation synchronously with inspiratory effort until a preset pressure is met. Pressure is maintained until inspiratory flow is reduced to a percentage of peak flow that depends on the exhalation sensitivity setting for the inspiration, when the ventilator cycles into exhalation. Available in SIMV or Spontaneous modes.

**PSI**

Pounds Per Square Inch.

**PSV (Pressure Support Ventilation)**

Pressure support ventilation.

**Rebreathing**

The patient breathes his/her exhaled gas.

**Respiration rate**

The number of breath cycles (inspiration + expiration) completed within one minute. Normal resting adult respiratory rates are from 12 – 20 breaths per minute (bpm).

**Rise Time**

This determines how the target pressure will be reached, and indirectly defines the minimum inspiration time.

**Rtot**

Parameter measured by the ventilator equal to the total number of breaths per minute (bpm).

**Sensitivity**

This adjustable parameter determines the amount of inspiratory effort required by the patient before the ventilator delivers an assisted breath, or demands flow in the case of a spontaneous breath.

The Puritan Bennett™ 560 Ventilator is flow-triggered, with sensitivity levels in the range from 1 to 5: the lower the number, the more sensitive the trigger.

**Sigh**

A sigh is an increased volume of gas delivered to the patient at a set rate. i.e. every 50 breaths.

**Spont Cyc (Spontaneous Cycling)**

This is the percentage of ventilation cycles initiated by the patient over the previous 24 hour period.

**Spontaneous**

A ventilation mode that delivers assisted breaths only. Spontaneous mode does not provide breaths if the patient does not make an inspiratory effort greater than the sensitivity settings and there is no apnea backup rate.

**Standby**

The operational mode of the ventilator where it is powered (power supply **I/O** button set to the **I** position), but is not ventilating the patient.

**SIMV (Synchronised Intermittent Mandatory Ventilation)**

A ventilator mode which provides a mechanism for synchronising the ventilator-delivered breaths with a patient's inspiration, as detected by the ventilator.

**Tidal volume (Vt)**

Volume of gas delivered to the patient in a breath.

**Unfreeze**

Resumption of the waveform plot tracing on the ventilator's display.

**V A/C (Volume Assist / Control)**

A ventilator mode which provides machine-initiated breaths are delivered at a clinician-set volume inspiratory time, and rate.

**Vent Time (Ventilation Time)**

The ventilation duration data is based on the patient counter and shows the total ventilation time in hours and minutes over the previous 24 hour period.

**Volume breath**

Inspiration of the selected volume, delivered over the selected inspiratory time.

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